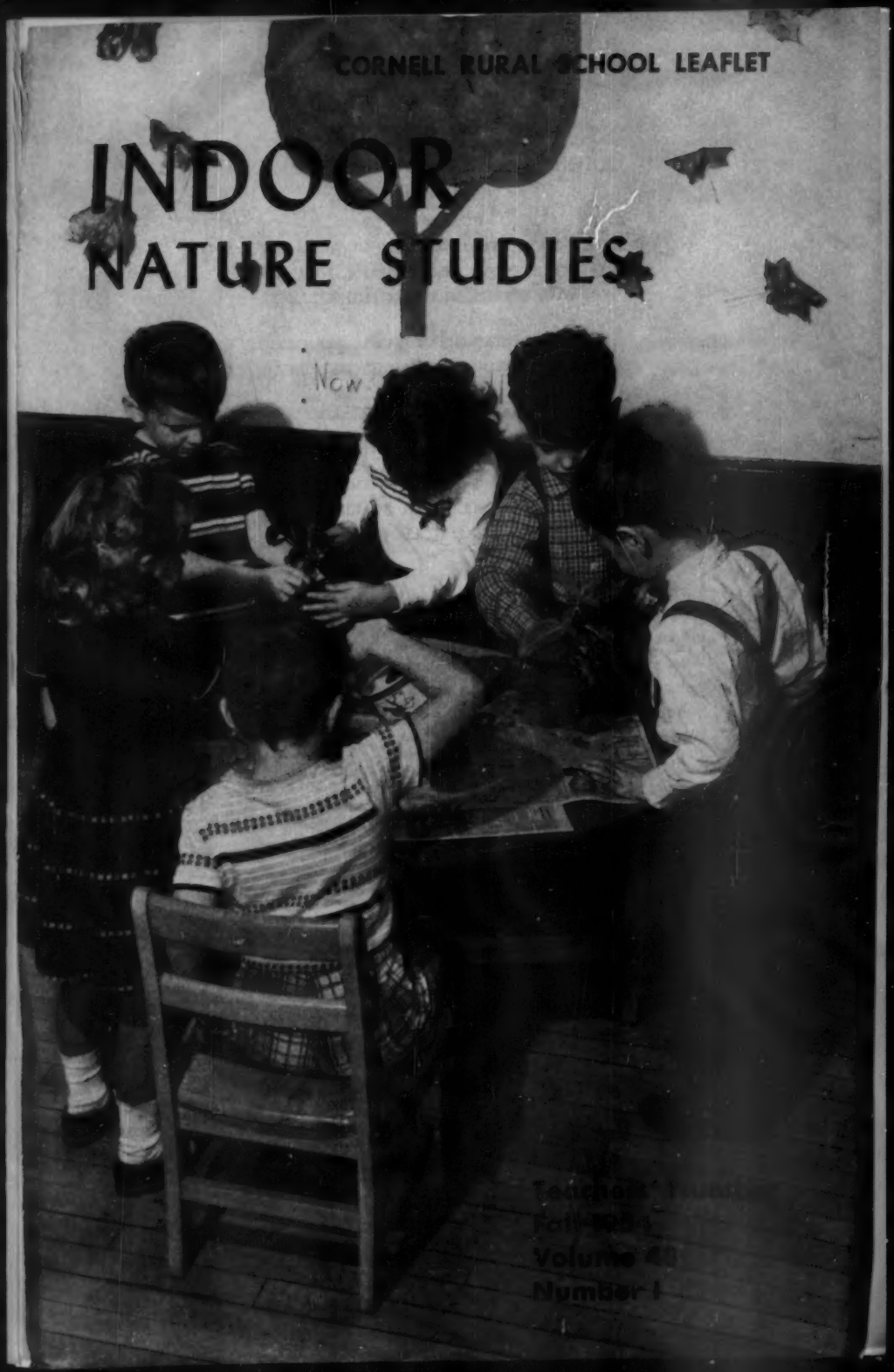
CORNELL RURAL SCHOOL LEAFLET

# INDOOR NATURE STUDIES



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*Contents*



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# Indoor Nature Studies

*By* Eva L. Gordon

This Cornell Rural School Leaflet is written as a companion to *Outdoor Nature Studies,* the issue for Fall 1953. Outdoor science studies usually lead to related indoor activities: further observations, experiments, search for desired information, discussions of new facts and questions, and plans for new experiences. Then, too, boys and girls often bring to school science materials that offer opportunities for learning too good to miss, and schoolroom studies involve many different types of approach, among which activities are important.

Activities in themselves are not necessarily effective means of learning. A child can put together and operate a simple electric motor without achieving much understanding of the scientific principles upon which it depends; or make a large and attractive collection of insects without knowing much about the creatures themselves or their relation to himself and his environment. Hence, the activities selected for this Leaflet were chosen on the basis of possible contributions to science learnings ordinarily a part of elementary science programs. They are intended not as ends in themselves but to be incorporated in science studies or in other classroom activities wherever they will help to achieve the objectives set up by teachers and children. Each one should be evaluated for its suitability both as a part of a particular study and for the children who are to engage in it.

In this Leaflet, as in its predecessor, emphasis is placed on studies of living things. This is not because the physical-science and earth-science aspects of a well-rounded nature study or elementary science program are of less importance. Rather, it is because each is so important as to demand emphasis in Leaflets to come.

Indoor science activities, like outdoor activities, help to make science principles real and thus to increase understanding. They provide opportunity for experimentation or for close or frequent observations; they supplement or stimulate outdoor experiences; and they serve in other ways to make children at home in a world of science. They also make other more general contributions to the overall education of children.

Well-maintained aquariums and terrariums, growing plants, and evidences of other science activi-

ties add to the attractiveness and interest of the classroom. Usually the children themselves recognize this fact, are proud of "our" room, and are eager to share their pleasure in it with parents and friends. Often in classrooms where science is an important activity, the science area is the high spot of the room, both for the children who work in it and for child visitors who have a way of wandering in. New interests are stimulated there, and new appreciations built up. There, children find leisure-time occupations as well as opportunities to perfect familiar skills and to develop new ones.

Science activities, in common with other similar undertakings, provide or contribute to problem-solving situations. They offer opportunities to practice principles of conservation. They help to develop cooperation, initiative, and acceptance of responsibility. In short, they play a real part in achieving that *general education* of which Professor Winsor wrote in the Leaflet for September 1952.

### Room and Other Necessities

Space for science activities is often a problem. Many classrooms are small or overcrowded. It is ideal to have a generous work space: plenty of room to put needed materials, tools, and references, a place where children can learn to work safely and utilize materials efficiently, where they can set up demonstrations and try for themselves "experiments" that others have presented; space to make plans, share experiences, record learnings and exhibit results. But lack of space need not rule out all activities. It is important to keep them simple, to have no more than one or two in progress at one time; to remove completed projects promptly and to store or dispose of equipment and materials no longer in active use.

In elementary schools the equipment used should be simple. Most of the necessary materials can be found at home, at school, or in the community. Helpful suggestions of materials and directions for making equipment are included in teachers' manuals for elementary science textbooks and in several of the books listed on pages 62 to 64.

An improvised, removable table or one that folds, a wide wall shelf, or several desks pushed together (if there are any to spare) will meet most needs for space. Window sills often are wide enough to be useful. The work surface should be protected by a cover of oilcloth, linoleum, or some other material that cannot easily be harmed or that can readily be replaced.

Whether the science area is large or small, some "housekeeping" is demanded. Teachers who have carried on an active science program find that children are usually glad to do most of the work but need some supervision.

## Words from a Primary-Grade Teacher

*By* PATRICIA ADAMS

This has undoubtedly been said before—but, to me, one of the most important goals of science for young children can be summed up in two words: *thoughtful observation*. We want to teach children to see and to wonder while they still have those tendencies strongly intrenched. We realize, I think, that young children are intensely awake, aware, and curious, but that often these attributes gradually grow less pronounced. On a walk, an adult usually sees less than a child. Science offers an opportunity to build habits of observation that will continue. So, always with my classes I try to emphasize watching.

In a classroom where one wishes to stress observation, a philosophy of what I call democratic teaching is absolutely necessary. A teacher cannot expect children to observe an aquarium or watch a pet in its cage if members of her class must always be in their seats. She cannot expect to be uninterrupted in a reading group or other activity if a child suddenly makes, to him, a wonderful discovery. He's very likely to blurt out, "Mrs. Adams, the frog ate a fly." It follows then, that a teacher cannot expect *absolute* silence. She must expect not to be able to assess all the learning that takes place; and to have no way to test youngsters on everything they learn.

The teacher who wants a classroom where free observation is the rule must develop a responsible freedom on the part of the children. Each teacher has her own way of doing such things—here is my way.

The children and I discuss the situation. "We all want to see and do things in this room. We have to do certain things that require quiet. Can you read well if other people are talking? Can you learn your spelling words if the room is noisy?" The answer will be, "No." Then, "What should we do so that we can do *both* sorts of things. We want to be able to move around when we have free time, but at the same time others may want to study. How could we do this? *Can* we do this?"

Children in my room have always responded in the affirmative. From this sort of discussion, rules have arisen which seem to govern our room well. Chaos does not reign in my room. True, there are times when I, like other teachers, cannot be democratic but children usually understand when they have taken liberties with their freedom. If there are infractions of the rules, the children themselves will usually suggest penalties. Often the teacher needs to remind some youngster that *he* may be the next one to receive punishment, so perhaps the chastisement he suggests should not be too

unreasonably severe.

To a teacher who has become accustomed to "every child in his place," to have them moving about the room sometimes is unbearable. But if she puts up with it until she and the children are used to it, it pays off in happy interested children—and in less police activities for the teacher. I think it also pays off in increased abilities in the children: observational ability, self-reliance, initiative, responsibility, and surely many others.

## Indoor Studies of Living Plants and Animals

LIVING things and their ways are interesting to most persons and especially to most children. To have plants and animals in the classroom under proper conditions provides learning opportunities that no teacher of science can well afford to miss. In outdoor studies living things are seen in their natural environment, an experience that cannot be matched indoors. But in the classroom a closer view of many plants and animals is possible; and some kinds which cannot or do not live in the immediate environment can be observed and compared with local forms.

Aquariums and terrariums are well-known means of keeping living things in the classroom. Potted plants or plants in indoor window boxes add to the attractiveness and contribute to the science activities of many schoolrooms. More and more teachers are coming to appreciate the educational and interest value of the great variety of animals that can be made comfortable in captivity.

In the following pages are accounts of experiences with living things in several elementary classrooms as well as suggestions for "setting the stage" for simple classroom studies of living plants and animals. For any such activities, cooperative planning and the sharing of responsibility between teachers and children are essential if maximum values are to be achieved. It is important that the children participate to the level of their ability.

*These kindergarten aquariums drew daily inspection*

*Photo by Doreen Perelli*

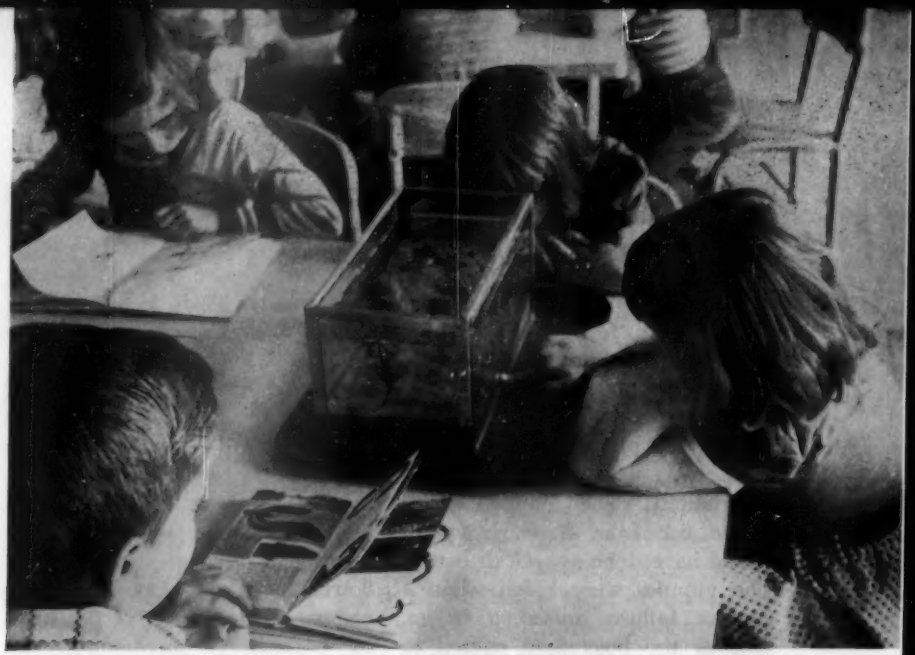


*Photo by Doreen Perelli*

*Kindergartners in Search of Answers to Questions*

## Aquariums

A WELL-KEPT aquarium is a small, attractive, ever-changing world in which much can be observed. It is one of the easiest ways to keep living things in the classroom, and, once established, usually requires little care.

On pages 7 to 13 are accounts contributed by teachers who have had aquariums in their classrooms. Suggestions for additional science studies follow.

A brief summary of points to be considered in setting up and maintaining aquariums is given on pages 21 to 26; brief, because many teachers know how to make and manage an aquarium, and children often have had a part in caring for one at home. For those teachers who wish more help or references to use with their pupils, a wealth of material is available, much of it free or inexpensive. Some is listed on pages 62 to 64.

### Experiences With Aquariums

**Our Aquarium.** Setting up our aquarium (a 5-gallon, rectangular tank) was a class project. Each handful of clean sand (cleaned by a committee after school) was put into the aquarium by a different child. Each plant was planted, and each pitcherful of water was brought and poured in (onto a

paper laid over the plants) by a different individual. Meanwhile I discussed with those not occupied why the process was done as it was, suggested possible inmates and how to feed and care for them, conjectured on what the children might see, and otherwise kept up an active interest.

After the plants had had a few days to become established, I contributed some guppies—small native fish from a nearby pond would have done as well or better. The guppies were killed when a furnace failure caused a freeze. One of the boys then offered to bring Swordtails, so they were what we had most of the year.

We found that a light (a goose-necked lamp with a 60-watt bulb) burning over the aquarium day and night kept it "really humming." Swordtail babies were born faster than the adults could eat them, so several young ones grew to full size. Snail egg masses appeared in many spots on the sides of the aquarium and on the plants. The tiny eggs hatched, and the small snails were everywhere.

One day during an arithmetic lesson with the first grade, a second grader came to me and said, "Mrs. Adams, come see the snails. They're acting funny. I think something is wrong." I could see that two red ramshorn-type snails (where I got them I do not remember, but they are frequently used in tropical aquariums) were mating, a fact which I simply stated. The children observed the process with equal matter-of-factness. I invited the first grade to look first (since I was working with them). Then I allowed the rest of the children to come up three at a time. I chose the first three, and directed the remaining groups how to follow in turn. The first grade and I went on with our work. By the time we had finished, the rest of the children had seen the drama in the aquarium. Then I recalled previous discussions of flower parts and pollination. I compared the mating of the snails to pollination, mentioning that each snail had both sperms (a new term) and eggs but that they did not "pollinate" (fertilize) themselves. The fact that these snails were both male and female was fascinating to the children. Some of this "talk" was undoubtedly over the heads of a first, second, third, and fourth grade group, but such discoveries and discussions are good beginnings of sex education.

Whenever someone discovered and reported something especially exciting, the whole group went, by rows, to look at the aquarium. This, however, is a limited way to observe. So, I put cards containing directions for observations on the aquarium table. Children were permitted to choose a card and follow its directions when they had free time. The following are examples: *Card A:* (1) How many fins do Swordtails have? Show

them in a picture. (2) Draw a picture of a snail egg mass. (3) How do snails move? (4) Does one fish seem to "boss" the others? *Card B:* (1) Draw a picture of a female Swordtail. (2) Draw a male fish. (3) How do snails eat? Try to find out by watching. (4) How many kinds of snails are in the aquarium? Draw a picture of each. *Card C:* (1) How many kinds of plants are in the aquarium? Draw them. (2) Draw an aquarium. Put all the necessary things in the picture. (3) How many baby fish can you count? (4) How many baby snails can you see?—*Patricia Adams*

**Kindergarten Aquariums.** The projects and interests that develop from a classroom aquarium are almost unlimited in number and variety. The personal interests of both the children and the teacher help to determine which direction the line of study will pursue. Often this can be controlled by the way the aquarium is developed and by the activities the children themselves perform, as children tend to be most interested in those phases they do for themselves. This was shown by the reactions of two kindergarten groups to almost identical aquariums.

The first aquarium was a class project from the beginning. As in Mrs. Adam's classroom, each child helped to build the aquarium and all were vitally interested in the "whys and wherefors" of each step. New understanding of the physical world came from questions such as these: "Why did we let the aquarium stand for a day or two before we added even the plants?" "To let out the chlorine." "Yes, but what is chlorine, where is it in the water, and who put it there?" This introduced a new realm of concept. For example, the word *gas* came to mean not only a fuel, but a state of matter, such as *liquid* and *solid*. The children enjoyed thinking of the carbon dioxide gas that bubbles in soda pop, and gained a new concept of the air they breathe as a real substance. They were interested in dissolving things in water and in what makes water safe to drink. The kindergarten quickly noted the rainbow caused by the water acting like a prism and soon discovered that a ruler partly under water looked bent. It was easy to feel that the ruler was still straight and they were satisfied with the partial explanation that the water bent the light by which they saw the ruler and made a straight thing look crooked. These discoveries brought a new interest to water play during activity period and started many other water experiments.

When plants and animals were added, they were interesting to these children as part of the whole aquarium. Watching the plants bubble oxygen was just as fascinating as watching animal behavior. All things were a part of the whole.

I presented the second group

with a "furnished" aquarium, which was planted and ready for animals. These children took no interest in the physical aspects of the aquarium and ignored the plants except to remark that they were pretty. The animals that *they* put in were the important part to them. This class loved to watch young snails develop inside the jelly-like egg masses. They were astounded when two ¾-inch snails appeared that they thought couldn't have hatched from any of the eggs. They came to the conclusion that one of the snails "laid" babies instead of eggs. They guessed that only the big operculate snails were large enough to have such big babies. These snails were examined carefully and the two siphons through which the young were born were thoroughly inspected. The class watched tadpoles hatch from eggs and were interested, but they did not have the same feeling that the other group had for the aquarium. Then we visited a pond.

Each child had his own unbreakable container for collecting and each pair of children had a kitchen sieve for fishing. From the moment they arrived to the time they were forced back to the bus, they were too busy collecting, observing, and questioning to have any time for bad behavior. I could not answer many of their questions, but this made it more fun as we could plan to find the answers together from books. Back at school we sorted our collections. Each child took home two animals for a private aquarium. We selected examples of each kind for the classroom aquarium and the remainder I returned to the pond. Now a new problem arose—the fish-fly larva killed everything it

*Armed with kitchen sieves, the kindergarten visited a pond*

*Photo by Doreen Parelli*

could catch. So, many smaller containers were set up around the big aquarium, each containing sand, water, a plant, and an animal. From this time until the end of school, a period of more than two months, the aquariums received daily enthusiastic attention, quite equal to that of the previous year. I doubt that any experience during the year was as satisfying to the whole class as the day we released the tiny frogs that had grown from eggs found that day at the pond.

Research in books played an important part in the knowledge gained by these children who could not yet read. They would look through a book until they found the "right" picture and then ask me to read to them about it. I feel sure that during their whole year in kindergarten, there was no stronger motivation to learn to read than this whole experience. The children could hardly wait to get to first grade to begin the mastery of this essential tool.

Both of these aquariums were started in the spring, because I felt that the kindergarteners were too new to school and too immature to start such a project in the fall. In the upper grades, however, where these problems are minimized, an aquarium started in the fall would provide interest for the rest of the year.—*Doreen Perelli*

**A First Grade Aquarium.** Our aquarium contained one minnow, four small rock bass, several snails, and some plants. The biggest fish intimidated the others and always got the most food first. The minnow hid in the plants most of the time. The snails ate the green algae that gathered on the larger plants and on the sides of the aquarium. It was fun to watch their mouths open and close as they slid along on the inside of the glass.

During the winter, the plants became scummy and brown. We had to weed out some of them. In the spring we emptied the aquarium, washed the sand, and started over, with only a few good plants. There were too few for the small fish to hide in. The largest rock bass ate the minnow. We dipped in the marsh and added mosquito larvae, mayfly nymphs, and duckweed.

We tried to find answers to many questions: Do fish close their eyes? Do they sleep? How do they stay in one place? Can they smell their food? Can they hear a tap on the glass?—*Ruth Josephson*

**Caddis-Worm Builders.** Most caddis-fly larvae may be recognized by their small, often cylindrical "houses" which they themselves make of silk they spin and of pebbles, sand grains, bits of wood, scraps of plants, or similar materials. Most swim or crawl about in the ponds and streams in which they live, pulling their cases with them (like underwater

trailers, a second-grader said). A few do not have movable cases. Most eat plants, some eat tiny animals, and some eat both plants and animals.

Caddis-worm cases have openings at both ends. The larvae hold themselves in their cases by hooks at the rear end of the body. As they feed or travel, they extend the front part of their body from the front end of the case. By gentle prodding at the "back door" with a slender stem or something similar, most caddis worms can be made to leave their homes.

My caddis worms were the kind that make a log-cabin type of case. [See *Insect Homes*, page 30.] I got them in the spring, from a quiet pond. My aquarium was a jelly glass, half full of pond water. I removed two caddis worms from their houses and placed them, with one house and two pieces of water plant, in the jelly glass. They went round and round the house, nipped at each other, but neither entered the case, which rested with its "front door" down. I put into the glass narrow strips of white paper, tinfoil, and cellophane of various colors. Within two hours both worms had started new houses. One made a long case of white paper, pieces from the old house, and a few bits of leaf and cellophane. The other began with pieces of leaf and added a few strips of cellophane and white paper.—*Anne Dunham*

**Dragonfly Transformation.** A letter from my file written years ago by a teacher of a one-room rural school recalled this experience. When I visited her school in May, she, the children, and I found a big dragonfly nymph in a pond across the road from the school. As we examined and discussed it, I remarked that it might transform to an adult dragonfly before school closed. The children wanted to see this change, if possible. They and their teacher made an aquarium—a quart fruit jar with a layer of pond mud and sand over the bottom, about 3 inches of pond water (to be replaced as needed), a piece or two of plants from the pond, some small insects for food, and (at my suggestion) a long stiff plant stalk that reached above the water nearly to the top of the jar.

Day by day they watched, but nothing happened. The last day of school came, and a conference was held which led to an agreement that the teacher take the aquarium and its inhabitant home. Most of the children's homes could be reached by party-line telephone, the children pointed out, and perhaps they could still see their pet transform. One morning the teacher found the dragonfly nymph high on the dry plant stalk. The children were summoned, and most of them saw at least a part of the emergence from the dull nymphal "skin," the gradual expansion of the clear, glassy wings, and the

final departure of the adult, perhaps to return to the pond from which it came.—*Eva Gordon*

**A Woodfrog Family.** On a Saturday in April we brought home a small jar of woodfrog eggs and a larger jar of water from the pond in which we had found the eggs. We had never seen tadpoles hatch and grow up, and we thought it would be fun.

A shallow enameled pan about 10 inches in diameter, with pond water about 2 inches deep became an aquarium. We put about 20 frog eggs in it, and set it in a cool corner, out of direct sunlight.

Three or four days later the eggs began to hatch, and finally ten active, black tadpoles populated the aquarium. Food became a problem. At first small things in the pond water supplied this need. Then we put in a succession of algae-covered stones from a nearby stream. The tadpoles bobbed along the surface of the stones, scraping off the algae with their small round mouths. Later, tulip leaves from which we had stripped the epidermis, lettuce, and thick fleshy leaves of live-forever proved tasty morsels. Occasionally we fed the tadpoles finely chopped raw beef or hard-cooked egg yolk, but we gave only small bits at one time and removed uneaten portions promptly so that the water would not become foul.

We added pond water from time to time as it was needed. When the first tadpole achieved front legs, we put in a stone that projected above the water and fastened a tight cheesecloth cover over the top of the pan. By the middle of June, the first of the tadpoles had transformed to frog form. We found him sitting on the stone, seeming to us oddly satisfied with himself. The others soon followed. Seven of the original ten lived to be set free in a woodland much like that in which we found the eggs. In natural conditions, probably an even smaller proportion would have survived. And to us the experience was fascinating from start to finish.—*Eva Gordon*

## Some Aquarium Studies

The experiences described in the preceding paragraphs are only a few of many discoveries and adventures possible with a schoolroom aquarium. Much can be learned without specific identification of the plants and animals, although many can be identified, at least to group, with the help of references such as some of those listed on pages 62 to 64. A large magnifier of the reading-glass type is a useful aid to observation.

Just what the plants or the animals are, however, is far less important than how they and the aquarium in which they live enter into the daily learning experiences of the children. A good aquarium can contribute greatly to the building of many understandings: how living things differ; how they meet

their basic needs; the interdependence of plants and animals; how living things affect and are affected by their physical environment; and many others.

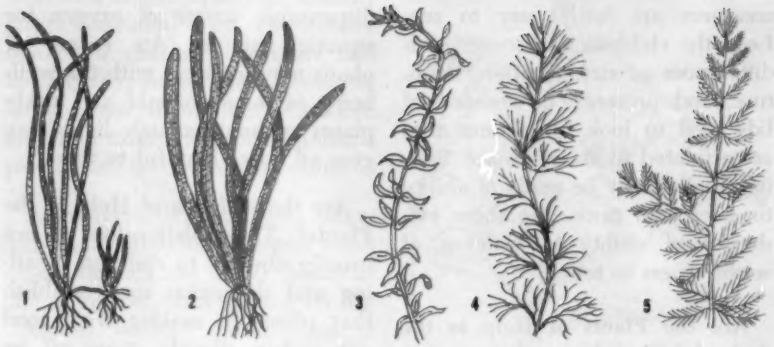
Field trips to nearby ponds, marshes, or slow streams to collect aquarium inhabitants should be taken wherever possible. Not only can the plants and animals be observed in their natural environment, but that environment can be studied to learn how to provide suitable indoor homes. If children have noted that ponds outdoors are lighted only from above, it is easier for them to realize that they may need to shade or cover at least one side of an aquarium near a window. (A mirror, taped mirror-side in, to the "window side" of the aquarium serves well. It cuts down the light; it also makes the interior of the aquarium seem larger and brighter.) Watching animals capture a bit of food, come to the surface for air, or scuttle to cover when disturbed is sure to bring awareness of needs that must be provided for in the aquarium.

If field collections are made, either by the group or by individuals, care should be taken to learn of and abide by regulations. Learn when and where collections are permitted, whether permits to collect desired forms are needed, and what creatures, if any, may not be taken. State game laws and regulations of the Department of Conservation will answer such questions. The local game warden can help.

Pet shops, variety stores, and home aquariums are other sources of aquarium plants and animals.

**Aquarium plants.** Differences in size, in form of leaves, and in habits of growth are easily observable. Which plants have long grasslike leaves? much-cut leaves? How many kinds lie limp unless supported by water? Note how easily and harmlessly these can be bent or pushed about by moving water. Which grow from rooted crowns, as do Sagittaria and Vallisneria? Which grow from the tips of branches, as does Anacharis (also called Elodea)? Which grow wholly under water? Do any float on the surface or send up leaves that float? The algae that sometimes coat the walls and color the water green can be used to introduce the concept of microscopic plant life. Only in masses do most of these plants become conspicuous.

**Many Kinds of Animals Live in Water.** Aquarium animals range from those of microscopic and nearly microscopic size to backboned animals, such as fish, turtles, frogs, and salamanders. Discovering tiny ones, such as Cyclops which are almost too small to be seen, is exciting. So also is learning how these animals differ in form, in ways of meeting the general needs of living things—food, air, protection, and provision for re-




*Drawing by Doreen Parelli*

*Some Plants for Schoolroom Aquariums*
*1. Vallisneria, Tape Grass; 2. Sagittaria, Arrowhead; 3. Anacharis (Elodea), Waterweed; 4. Cabomba, Fanwort; 5. Myriophyllum, Water Milfoil*

production—and in many other ways.

**Animal Life in the Water.** Most fish spend their whole lives in the water, as do many other creatures. Other animals live in water only when they are young. Dragonflies are one example. Some animals divide their time between life in the air and life in water. Because most turtles and many adult frogs and salamanders have this latter habit, they are not so well suited for life in an aquarium as for living in a terrarium or a vivarium that provides for both land and water life.

Some aquarium animals—fish, for example—are free-swimming. Open water, in which they can move easily, is needed. Other animals are bottom dwellers, some are burrowers, and some live chiefly on or among the plants. Which of these groups are represented in the classroom aquarium?

Encourage children to observe these differences in habit, to learn more about them by reading, and to make provision for them in planning schoolroom homes for living things. Dragonflies, for example, need a place to transform above water. Turtles, if kept in an aquarium, should have a place to rest out of water. Insist that animals be freed that cannot be made comfortable.

**Living Together.** Learning what plants and animals will live together in an aquarium is a real problem. Turtles, except tiny ones, are bad companions for fish—they nip fins and tails. One big fish put with several smaller ones is likely to eat his tank mates. Several fish seem to thrive better than one fish alone. Some animals uproot or destroy plants.

**Senses and Sense Organs.** The eyes of most of the larger aquatic

creatures are fairly easy to see. Lead the children to discover such differences as size, location, structure, and presence or absence of lids, and to look for actions that seem related to ability to see. Similar studies may be made of ability to smell and taste. Are there evidences of ability to hear or of sensitiveness to touch?

**Are the Plants of Help to the Animals?** That some aquarium animals eat plants (living and dead), cling to them, and find shelter and shade among them are easily observable facts. Understanding the oxygen and carbon dioxide relationships between the plants and the animals is more difficult.

Carbon dioxide, given off in the respiration of animals, and wastes from their bodies tend to make the water impure. In their respiration, plants, too, take in oxygen and give off carbon dioxide. Carbon dioxide does not pass readily from water to air and back. When plants carry on photosynthesis, a process that occurs only when there is enough light, they *take in* carbon dioxide from the water and *give off* oxygen. Both phases of photosynthesis would seem to be of benefit to the animals; removal of carbon dioxide and addition of oxygen.

It has been found, however, that most of the dissolved oxygen used by aquatic animals comes from the air that is absorbed at the surface of the water. Plants are not an indispensable source of oxygen for aquatic animals. An excess of plants may interfere with the well-being of some animals, and sickly plants without enough light may give off gases harmful to them.

**Are the Animals of Help to the Plants?** This relationship is not usually obvious to children. Reading and discussion may establish that plants in making their food use carbon dioxide given off by the animals and that animal wastes provide some substances of value to the plants. Animals help to keep plant growth in control. Is this control an advantage to the plants?

**Many Animals Eat Plants.** Snails and tadpoles often serve to introduce this concept. Children can watch them scrape algae from aquarium walls or from the larger plants. Because so many plant-eaters feed on microscopic plants, it may be difficult to show how many kinds—and individuals—are directly dependent on plants for food and how plants, directly or indirectly, are the basic food of all animals.

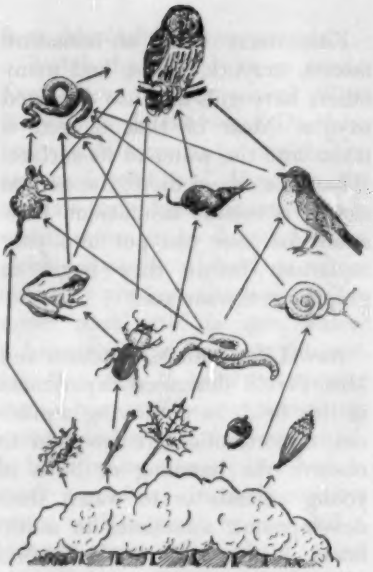
**Some Animals Eat Other Animals.** A community aquarium soon leads to this understanding. Usually it is fairly easy to see that some animals are predators and some are prey; that one kind of animal may prey on other kinds and in turn be preyed upon. Some are cannibalistic. The whole concept of food chains is demonstrated time after

time in a mixed aquarium. Usually larger animals prey on smaller ones, but dragonfly nymphs and leeches frequently attack creatures larger than themselves. Children may find insects and other animals parasitized by bright red mites.

**Scavengers.** Snails, clams, crayfish, some kinds of fish, and some other animals eat dead plant or animal matter, thus serving on the "cleanup squad." (One clam is enough for an ordinary aquarium.)

**Getting Food.** Watching water animals get food, seeing what they take, and noting how they eat it is endlessly fascinating. Some creatures lie in wait, some stalk their prey, some pursue it, some—the plant-eaters and the scavengers, for example—merely seek a source of supply. Some chew or tear their food, some swallow it whole, some simply suck in the juices of plants or animals. Some turtles can eat only under water.

**Getting Oxygen.** Children will discover that many of the interesting ways and structures of aquarium creatures are related to the need for oxygen. Plants that grow under water take their oxygen from air dissolved in the water. Most water animals obtain their supply of oxygen in one of two ways: (1) they take free air at the water surface, or (2) they use air dissolved in the water. Turtles must come to the surface at intervals; so must adult newts. Frogs



Drawing by Stephen Collins

*A Food Chain*

*In water, too, animals depend, directly or indirectly, on plants for food*

often float with their nostrils above water—they also absorb some air through their skins. Adult bugs and beetles that live in water, and some immature insects also, come to the surface for air, a supply of which they carry below. Often some such insects can be seen, hanging head downward or head up, at the water surface. Some diving beetles have air chambers under their wing covers. Other beetles carry their air as a shiny silvery covering on the underside of the body. The water walking-stick pokes a long, tail-like breathing tube through the surface film to get its supply.

Fish, many kinds of immature insects, crayfish, clams, and many others have gills and use dissolved oxygen. Most of that oxygen is taken into the water at its surface. When fish crowd there, the oxygen supply is usually insufficient. How many fish can you put into your aquarium before they begin to gulp air at the surface?

**New Life.** Both Mrs. Adams and Mrs. Perelli described experiences in this field. In a thriving aquarium, opportunities are frequent to observe the hatching or birth of young animals or to watch their development, sometimes to adulthood. Plants such as Vallisneria often spread rapidly by putting forth runners from which new plants appear. Occasionally Vallisneria or Anacharis bloom in an aquarium.

Snails breed rapidly, and are easy to keep. A small container, some stagnant water, a little bottom mud, and a sprig or two of an aquatic plant are enough to provide a home. The common native freshwater snails of New York State are egg-layers and hermaphrodites (each individual has both male and female reproductive organs). Commonly sperms from one individual fertilize the eggs of another. The small, jelly-like egg masses usually are fastened to the walls of the aquarium or to plants. A good magnifier is a help in following the hatching and growth of the young snails. One can buy Japanese live-bearing snails from many pet shops.

Often in fall or spring, female crayfish with masses of eggs attached to the undersides of the bodies are captured. It may be possible to watch the young hatch in an aquarium. They cling to the female's swimmerets and ride about for several days. Crayfish do best in a shallow dish (covered), and should have a small heap of pebbles and sand to hide in. Crayfish frequently molt in captivity.

Raising frog or toad tadpoles from eggs is an unavoidable (and rewarding, if successful) spring activity in many schoolrooms. A generally useful method is described on page 13. Only a few eggs should be collected, the rest left where they were found. Unhatched eggs should be removed after most of the tadpoles have hatched. A mimeographed bulletin, *Some New York State Frogs and Toads*, available from the Leaflet office, contains helpful information about kinds of frogs, where and when eggs are laid, tadpoles and their transformation. Generally, salamander tadpoles are more difficult to raise than are frogs or toads, partly because they need live animal food.

Immature forms of insects frequently molt or change to adults in an aquarium. Mosquitoes may develop from eggs to adults. Learning about the life cycle and habits of insects offers opportunity for research and many experiences.

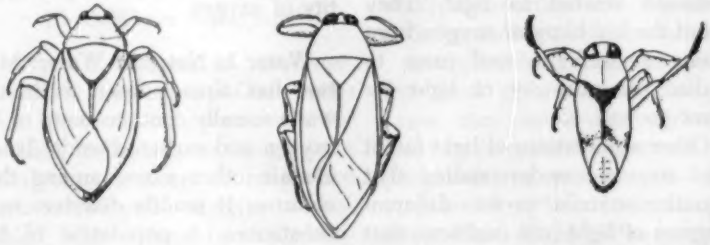
**How Are Water Animals Protected?** Some hide. Some are so colored or formed that they are difficult to see unless they move. Some bite, or pinch, or jab with their mouthparts. Some have heavy shells or other covering. Some make shelters. Look for other ways these animals may escape their enemies. Caution children that giant water bugs and backswimmers, held closely in a hand, can inflict a painful wound with their beaks.

**Moving Through Water.** Water is more than 750 times as heavy as an equal quantity of air. It supports things in it better than does air, but it offers greater resistance to movement through it. Water animals are adapted in various ways to meet this situation. Many are smooth-bodied and stream-lined in form; many have flattened or hair-fringed, oar-like legs, such as the water boatman's hind legs. Crayfish can push powerfully with their "tails." Snails drag their bodies forward with their one fleshy foot. Mosquito larvae wriggle.

Watch the animals in an aquarium. How do they move? What body parts do they use? Do these body parts seem to be modified to aid in locomotion? How do the animals turn? balance? move backward? move up or down? Do any swim constantly or hold on whenever they are far under water? Can some "stand still" in open water?

Insects are particularly interesting. It is easy to keep quiet-water forms but swift-water forms require more oxygen than can usually be supplied. Insects live best in small aquariums, in fairly shallow water with a plant or two and a bottom cover of sand or pond mud. Unless you segregate the various kinds, the larger animal-eaters will soon be the sole survivors. Cover the containers to prevent escapes.

**Moving at the Water Surface.** The surface film of water is strong enough to support the weight of some small creatures. The feet of



*From Slingerland-Comstock Company*

*Aquatic Insects Dangerous to Handle*
*Left, Smaller Giant Water-bug (about 1 inch); center, Giant Water-bug (from 2 to 3 inches); right, Backswimmer (about ½ inch)*

Usually at least some of these plants, or others as useful, can be collected from nearby waterways, but tank-grown specimens from pet stores or similar sources usually grow better in schoolroom aquariums. Whatever their source, it is wise to disinfect plants before you place them in an aquarium. Allow them to stand for an hour in a dilute solution of potassium permanganate (use enough crystals to give the water a pinkish tint) or for a few minutes in salt water (about 2 tablespoonfuls to 1 quart of water). Rinse them thoroughly.

Plant rooted plants, such as Vallisneria and Sagittaria, with the roots well spread and with the crowns just at the surface of the sand. The lower ends of non-rooting plants, such as Anacharis, should be pushed into the sand. Small pebbles around the base of the stems help to anchor the plants.

Plants may be put in place in the moist sand, before water is added, or they may be planted after the aquarium has been filled to a depth of a few inches. When they are in place, fill the aquarium to within a inch or so of the top. Allow the plants several days to become established before you introduce any animals.

**Aquarium Animals.** For the usual school aquarium, animals that normally live in quiet water are best suited to the conditions of light, temperature, and care that can be given to them. Goldfish are colorful and hardy, but native pond fish, such as bluegills, sunfish, small catfish, and several kinds of minnows, can also be used. Hardy kinds of tropical fish are useful if proper temperatures can be provided. Some amphibians, certain kinds of turtles, fresh-water snails, aquatic insects, and other small aquatic creatures can be added to the list.

Overcrowding is perhaps the greatest danger. Aquarium animals, like others, are dependent on oxygen for life. Some get their supply from free air but many use oxygen from air dissolved in the water. No more animals can live comfortably than can be adequately supplied with oxygen.

For goldfish and the native minnows, a usual rule for aquariums of ordinary proportions kept at moderate temperatures is 1 inch of fish (not counting the tail) for each gallon of water. For very deep or very shallow aquariums, 1 inch of fish for each 20 square inches of exposed water surface is a good rule.

In addition to 1 inch of fish, a gallon of water in an ordinary aquarium usually can accommodate one tadpole, one snail, and several water insects, or the equivalent.

Keep new animals to be added to an established aquarium in the carrier in which they arrived until the water in both containers reaches approximately the same

Be sure that the chosen container does not leak and that it is thoroughly clean. Fill it with strong brine or with a concentrated solution of potassium permanganate. After several hours, empty it and rinse it thoroughly to prevent harm to plants and animals.

**Placing the Aquarium.** Always put a large aquarium in a permanent place before you fill it. Choosing this permanent place is one of several important problem-solving situations involved in setting up an aquarium.

Aquariums, especially large ones, need even support to prevent strains and consequent leaks. Enough light is necessary to permit the plants to grow well. Indirect light throughout the day is best, but an hour or two of direct sunlight is not harmful. A north window is the best location; an east window ranks next. Too much direct sunlight may overheat the aquarium as well as stimulate the growth of green algae. If the sides of the aquarium become brown, and the plants look pale and begin to die, more light is needed.

The temperature of the water should be kept as uniform as possible—between 60° and 70° F. for most aquariums, but warmer for tropical fishes.

**The Bottom Cover.** An inch or two of coarse sand or of fine gravel covered with sand—just enough to anchor the rooted plants—makes a good bottom cover. Even "new" sand needs to be thoroughly washed in running water. Sand that has been used before in an aquarium should be boiled for several minutes. Heaping the sand toward the back makes the aquarium easier to keep clean—materials that need to be removed collect at the front.

**Water.** For a fresh-water aquarium, water from a pond where fishes live probably is best, but water from wells, springs, or streams may be used. Tap water is usually satisfactory if allowed to stand in open containers or in the aquarium for a day or two before plants are put in, to allow chlorine and other gases to escape (occasional stirring helps).

One way to avoid disturbing the bottom layer when you put in the water is to cover the sand with a double layer of newspaper or a piece of heavy wrapping paper, pour the water in gently, then remove the paper.

**Plants and Planting.** Although they are not indispensable, healthy, well-placed plants add greatly to the beauty of an aquarium. They also affect the animal life in various ways. Plan to arrange the plants to create a picture of which the front of the aquarium is the frame, as well as to afford shelter for the smaller animals and to allow free movement to all inhabitants. Many kinds of plants are available. Five of the most satisfactory are illustrated on page 15.

basement window. It should be filled with water and covered. Plants and snails may be safely left in it. Fish, too, may remain in it if they can be fed once or twice a week.

### Foods for the Animals

**Do not overfeed.** A good rule for fish is to give them what they will eat in 10 or 15 minutes. Feed them every day if the temperature of the water is above 70° F., otherwise every other day, or even less frequently. Most aquarium animals can get along without food for a considerable time.

Remove uneaten food promptly.

Many native animals must learn to take food in captivity, especially if the foods offered are substitutes for natural foods. Learn how and what they eat. Then try different foods. Vary the diet. Remember that the natural foods of many animals are other creatures that normally live in the same community.

The following list of foods and animals that eat them is incomplete. References and experienced aquarists will suggest others to try. Pond water usually contains much food for smaller creatures. Scavengers such as snails eat "left-overs" of many kinds and often need no special food.

*Commercial fish foods*—for fish, crayfish, tadpoles, water turtles, newts.

*Scraped or chopped raw beef, liver, or horsemeat; earthworms, whole or in pieces*—for fish, crayfish, tadpoles, turtles, newts and other adult salamanders, adult frogs.

*Bits of fresh fish, oysters, clams, or fresh-water mussels*—for fish, crayfish, turtles, and probably other animals, including some frogs, toads, and salamanders.

*Insects*, especially live water insects—for fish, crayfish, tadpoles, aquatic frogs, water turtles, newts, carnivorous aquatic insects.

*Small water animals other than insects*, including Crustaceans, snails, (and snail eggs), tadpoles, minnows, and others—for fish, crayfish, aquatic frogs, newts, water turtles, carnivorous aquatic insects.

*Algae and other aquatic plants*—for fish, snails, crayfish, tadpoles, water turtles, some aquatic insects.

*Lettuce and other fresh leaves, bits of fruit*—for snails, turtles, and perhaps other animals. Tadpoles will eat lettuce.

*Spiders, slugs, snails, sowbugs, land insects and their larvae, and other small animals*—try them for animal-eaters, especially adult frogs, toads, and salamanders.

*Cornmeal, oatmeal, yolk of hard-cooked egg*—for tadpoles, but sparingly.

*Powdered cuttlefish bone*—occasionally, for snails.

**Some Live Foods.** If a dark, cool, out-of-the-way place is available, you can raise earthworms fairly easily for winter food for

temperature. Fish should never be subjected to a sudden change of temperature of more than 2 degrees. A half-hour salt bath (1 teaspoonful of salt to 2 quarts of water) for new animals is a good precaution.

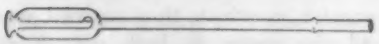
**A Cover.** A glass cover over a schoolroom aquarium keeps animals from jumping out, and dust and dirt from falling in. It helps also to reduce evaporation and to maintain an even temperature.

### Aquarium Care

Helpful tools are a small net (a kitchen sieve will do); a piece of rubber tubing about 5 feet long and ¼ or ⅜ inch in inside diameter, to use as a siphon; a razor blade, preferably with a holder; a dip tube.

Change the water only when it has become ill-smelling or unclean looking. Green water has several causes, the most common of which is too much light. It is not in itself harmful.

Replace water removed during cleaning or lost by evaporation with water of approximately the same temperature as that in the aquarium. Chlorinated water should stand for a time before it is added.



*A Dip Tube*

About once a week scrape down the sides of the tank with a razor blade or a piece of rough material such as felt. Clean the bottom with a dip tube or draw waste materials off with a siphon. Water removed by a siphon may be strained through several thicknesses of cheesecloth and returned to the aquarium.

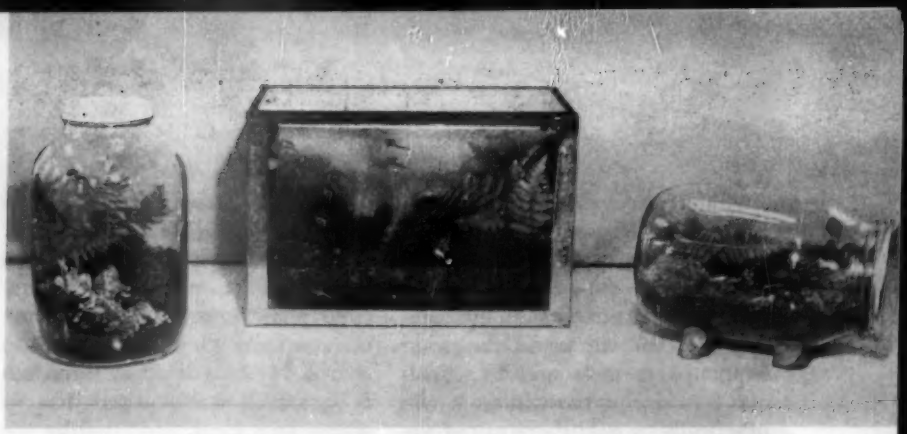
Promptly remove uneaten food and any dead materials, plant or animal. Break off the yellow older portions of such plants as Elodea that grow at their tips. Do not allow plants to overcrowd the aquarium.

Handle fish with wet hands or a wet net. Dry hands or net may remove the protective slime that covers a fish's body and expose it to harmful fungi or bacteria. Learn from references about diseases of fish and about other aquarium troubles and what to do for them.

Be sure to have a place where newts, turtles, frogs, and transforming tadpoles can get out of the water. Stones projecting above the surface are satisfactory. Only a few kinds of these groups of animals are well suited for life in an aquarium.

On cold nights, leave a light burning near the aquarium or cover it with a blanket. An electric heater and thermostat may be desirable.

In summer the aquarium may be taken to someone's home, or it may be placed away from direct sunlight in the classroom or near a



*A spring peeper is perched on the fern in the center of the large terrarium*

## Terrariums

A TERRARIUM is a glass-enclosed indoor garden that holds soil and growing plants, and can serve as a home for small animals that live on land. It can be an ever-changing winter garden in which a natural landscape in miniature can be arranged—a bit of woodland, desert, bog, or field; or a garden of cultivated plants.

Terrariums, whether group or individual projects, have many schoolroom uses. Some may be devoted entirely to plants and serve primarily for decoration, even though many science learnings can grow out of making, caring for, and observing them. Others may be primarily "guest-houses" for visiting animals or even long-time residents. In either type, children may gain experiences that contribute to the concept that living things are dependent on their environment and upon each other: each thrives best in a certain type of surroundings and suffers in an unsuitable environment or in one too well suited to its enemies. As children choose terrarium inhabitants much can be done to develop "conservation consciousness" and to practice active conservation (wise use) of plants and animals. The phenomena of evaporation and condensation that take place in tightly covered terrariums are fascinating. New avenues of interest and enjoyment are other valuable outcomes, as the following accounts by teachers (one of grades 1 to 4, and the other of grade 3) well show.

### Terrariums in Our Room

We (grades 1 through 4) had three terrariums this past year, all of which we kept going for almost the entire year. One stayed outside the window, where we could see it at any time. One was the home of a tree frog, two years old now. One housed salamanders.

A committee put each terrarium together, because the whole class couldn't help. The terrariums were

many animals. A tight wooden or metal container is needed, from 3 to 8 or 10 inches of rich garden soil, and some worms. Over the soil spread a thin layer of decaying leaves. Keep the soil moist, but not wet. About once a week add a small quantity of such foods as cornmeal, bread crumbs, wet coffee grounds, or leftover boiled vegetables. A cover of damp paper or cardboard helps to keep the soil from drying.

Mealworms, the larvae of a kind of beetle, are eaten with relish by many animals. They may be purchased at some pet stores, obtained at feed stores, where they are frequent pests, or a "culture" containing eggs, larvae, pupae, and adult beetles, may be bought from a biological supply house. A cloth or screen-covered glass jar partly full of wheat bran will serve as a rearing cage. Bits of dry bread, and pieces of apple, carrot, or potato, added occasionally, supply food and a little moisture. Ordinarily a colony, once started, will multiply, thus providing a study in insect metamorphosis, as well as a continuing supply of food.

*This praying mantis laid her egg-mass in a glass-jar terrarium. She ate swatted flies, a grasshopper, and cooked white of egg*

Small salamanders, tree frogs, and other small animal-eaters will eat fruit flies. Usually these insects are easy to get—an open jar holding pieces of overripe fruit, placed near an open window often attracts them. Some may then be captured simply by closing the jar. Fruit flies breed rapidly. Knowing that adults move toward light makes it easy to transfer some to another container for introduction into the eater's cage. In a terrarium, a self-feeder may be provided —an open bottle, containing a few pieces of banana and some developing fruit flies. Adults that fly out usually are promptly snapped up.

### Salt-water Aquariums

Except perhaps near the sea shore, marine aquariums offer special problems and hazards. Some of the references listed on pages 62 to 64 should be consulted if one wishes to embark upon this interesting and richly rewarding project.

of different sizes, but all were made like those described on pages 33 and 34.

Number 1 was of plate glass, and was placed outside the window so that we could see what happened to moss and to Christmas fern during the winter. It was practically as cold there as out under the trees, but we could see what was happening without going outside and could easily make many observations. The moss remained green, we found. The Christmas fern was green all winter, but most of the old leaves died in the spring and new ones grew in their places.

Oxalis (wood sorrel), as dainty and attractive as the fern, came up unexpectedly in the spring. The children concluded that seeds had been hidden in the moss when we collected it. By drawing on their knowledge of tulips and other garden flowers, we added the possibility that the new growth might come from underground parts of plants that had died down before we brought in our moss. We added the term *perennial* to our vocabulary.

During the winter, someone discovered beautiful formations of ice crystals on the inside of the glass. We brought the terrarium in for a time then, passed it around the room, and allowed everyone to lift the lid and look. This led, of course, to a discussion of why and how the frost formed and a suggestion that the same thing happens to windshields.

I had the tree frog when school started, but it is perfectly within the realm of possibility that a child may bring one (or some other equally adaptable animal) to school. My frog lived in terrarium 2, in which was a small dish of water, kept clean and fresh by the children. One child looked after the frog and its home for half the year, then another took over. Care included feeding and keeping the terrarium properly moist—in winter, in a hot schoolroom, terrariums do dry out. (Some youngsters are faithful about such duties, others not. A "duty" chart which they check daily helps.)

The frog seemed to offer a good opportunity for the children to begin to realize that some animals eat other animals. We human beings do not sympathize with insects in general, and the frog ate insects. I kept a culture of meal worms in a quart jar of bran. The person who cared for the frog regularly went to the jar, removed a few worms with forceps and dropped them into the terrarium. We learned that the frog usually ate during the night. A few children brought in moths (in season) for food. Some of the boys caught flies when they could.

Terrarium 3 was made in a hurry one day when a child brought seven salamanders to school. We kept them all winter in their moss-floored glass house and released them, alive and apparent-

ly well, in the spring. When they first came, the child who brought them carried their terrarium around the room so that all might see them. The terrarium then became the center of an "interest corner" for a few days. From then on, children occasionally looked at the salamanders which were usually well hidden in the moss.

A terrarium where animals are kept usually does not "look pretty." The inhabitants often disturb the plants, soil the glass, and otherwise disrupt their surroundings. We decided that the salamanders must feed on small creatures that were in the moss when it was collected. Evidence for this conclusion was the discovery of adult cranefliies flying inside. We found a picture of a cranefly, read about the insects, and learned that larvae of some kinds may be found in or near the soil, among the decaying plants, under bark, and in similar places. Many change to pupae and then to adults in such places.

We never fed the salamanders. In the spring we released all seven in suitable places. We chose seven children to put one animal each on the ground near a rock, in a damp area.

Sometimes children do not seem to notice what is happening to something in the room. A few exciting discoveries, pointed out by the teacher, will frequently lead the children to seek others for

*An "Interest Corner"*
***Use of color in the background and in the textile underneath directs attention and adds attractiveness***

worked out very well since Johnny, who could not read and report about small woods plants, could join the Pebble Committee whose job it was to collect small stones for drainage, the Dirt Committee, or the Newspaper Committee. The Safety Committee's topic of discussion was "Do and Don't with Glass."

Layers of newspaper were placed over cardboard at the front of the room. This facilitated the collection and watering of woods plants until the terrariums were ready. Each day as new plants arrived they were placed in groups according to species.

Then the day arrived when the glass was delivered. A drawing board was placed on each desk, and upon it four pieces of glass (the two sides and the two ends) were laid lengthwise side by side. [The terrariums were made as suggested on pages 33 and 34.] A small space was left between each two edges; the four pieces of tape for the sides were measured, cut, and placed sticky-side-down on the piece of glass that would eventually become the top.

Strip by strip the tape was laid connecting the four pieces of glass. Each tape was smoothed, again and again, so that it would adhere firmly. Then the four taped pieces of glass were carefully picked up, folded into rectangular shape, and the last edges were taped together.

Now the bottom! And, then, the terrariums were turned rightside up, ready for their covers. Again tape was measured and cut, for a hinge, protective binding, and a lifting tab. The tab and binding in place, the cover was taped on. All raw edges of glass were covered with tape to avoid any danger of cuts. The terrariums were placed on the window sills and table.

The next day arrangements of winter gardens were discussed. The pebble situation, the woods dirt, and the various plants were carefully scrutinized. It was the consensus that more plants were needed. To rectify this lack, the Plant Committee and the teacher journeyed to the woods and returned heavily laden with many varieties. We were even fortunate enough to discover some partridge-berry.

What fun we had the morning after! First the pebbles were placed so that they covered the bottom. Then came about an inch of woods dirt, humping some toward the back for miniature hills. In the front went a shallow layer of stones and pebbles, the better to show off the low plants.

*Partridge-berry*

themselves. If the discovery is worthy of the attention of the whole class (usually it is, amazingly enough), either we all stop then and there to look or I ask the discoverer to remind me at a time when we can better be interrupted. We treat things brought in by the children in the same way. For example, a child brought a large piece of mica which he had picked up in Connecticut. I asked him to remind me, immediately after rest time, to allow the rest of the class to examine it. Things such as mica will "keep" until a convenient time, and the responsibility of seeing that they are used can be shared with the child. Events in a terrarium often require immediate attention, but most are well worth the time they take.—*Patricia Adams*

**Thirty-six and One Little Terrariums**

One day I brought a big terrarium to school for the children. They were fascinated by it, and the first thing in the morning—often before jackets were off—they would go over to peer inside. Soon they were noticing changes: the fern uncurling and turning toward the light; the water forming on the sides and top of the glass. They were intrigued with the thought that the drops would eventually come down like rain. Once when it was raining Mary went to the window and watched the rain falling gently on the lawns. Then she went over to the terrarium, looked intently inside, and nodded her head. All was well with the gardens, inside and out.

As might be expected, the children (grade 3) soon began to wish that they had one of their very own. "Oh, could we, could we?", they asked with eyes that questioned, cajoled, and believed. After they had "won" their point—one that had been visualized long before my terrarium made its appearance—necessary details were enthusiastically discussed.

The size was decided upon: one that could be easily carried and would fit on an end table. The two sides, the top, and the bottom were to be 6 by 5 inches; the ends, 5 by 5 inches.

But where to get the glass? Several places were mentioned. Nothing would do but that we begin our inquiring that very afternoon. Several children who lived nearby telephoned their mothers for permission, and off we started on a glass-hunting expedition. Luck smiled on us. The owner of the first glass shop, after talking to the children, generously offered to cut the glass—for free! The children looked at him as if he were Santa Claus and thanked him repeatedly. Later all the children wrote him letters thanking him for his kindness.

The next day the various "musts" were put on the board, and committees formed. The children chose their preferred group. This

ods of construction. One method follows.

### A Homemade Terrarium

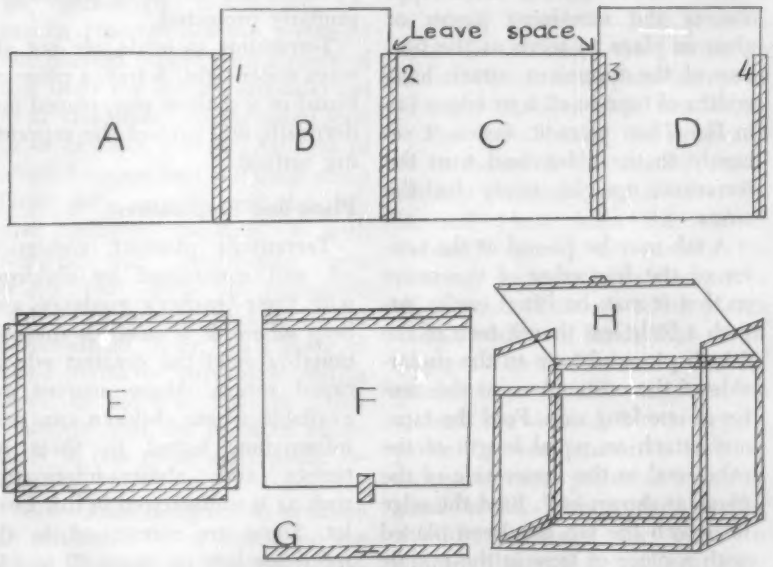
Necessary materials are: six oblong panes of glass of the same size. Single-thick window glass is satisfactory. Panes, 6 inches by 8 inches or 8 inches by 10 inches, make good terrariums for ordinary purposes, but smaller sizes may be used. A pan or tray underneath to give added support is advisable for larger terrariums of this type. Two pieces (for ends) may be squares to match the shorter dimension of the side pieces, if desired.

Waterproof adhesive tape, 1 inch or 1½ inches wide. A 5-yard roll will make an 8-by-10-inch terrarium.

Place four panes of glass (A, B, C, and D) on a table as shown in the diagram. Separate them by a distance slightly greater than the thickness of the glass, to permit later folding to form the sides of the terrarium.

Cut six pieces of tape the length of a long side of the glass, seven pieces the length of a short side, and one 3-inch piece. Place them where they can be reached easily —attached lightly to the table edge, or side-by-side, sticky-side-down on the two remaining panes of glass.

With short pieces of tape, fasten




*Drawing by Doreen Perelli*

*How to Make a Terrarium*

Everyone looked at everyone else's creation, and especially lovely spots were noted, admired, and analyzed as to why they were so delightful. Pleasant arrangements, it was decided, included making hill and valley formations.

Back now to their own gardens, placing the taller plants at the back, some in clumps and some alone—the tiny trumpets of lichen and the partridge-berry plants taking places of honor toward the front. The individual arrangements were really beautiful, but no more beautiful than the children's faces as they beamed with pleasure and satisfaction. The gardens were watered, and replaced on window sills and tables, so they might receive the proper light.

They were kept in school until it was certain that all was well. During these days, the children often talked and looked at what they called their "Thirty-six Little Terrariums." Each discussed and admired not only his own, but everyone else's garden. Many outsiders came, too, to look. Apparently the boys and girls felt that Mr. Kuppinger, the principal, was especially appreciative of their efforts and the beauty of the gardens, and asked if they might make him one. This they did, each contributing something in the way of toil, soil, plants, pebbles, or helpful suggestions. Although they loved it, it never quite made the exclusive "Thirty-six Little Terrariums Club," and the assortment was thereafter labelled "The Thirty-six and One Little Terrariums."

The pleasure in the gardens proved unending. Conversation often veered to them. Such comments as "One of my ferns has about reached the top of the glass," or "Last night there was too much moisture and I raised the cover for a while," were frequent. Even the next year the interest continued, and the children, in groups or singly, replenished their terrariums.

Truly of them it could be said, "A thing of beauty is a joy forever."—*Fern J. Duffany*

**Useful Containers**

Almost any glass or other transparent container that can be closed fairly tightly may be used for a terrarium. For schoolroom use, a square or rectangular case probably is best—it is easy to plant, and the living things within it can be easily observed. An aquarium tank, even a leaky one, is excellent. Goldfish bowls, ice-box dishes of glass or clear plastic, covered casseroles, bottles and jars of almost any size and description will serve. Gallon mayonnaise or other wide-mouthed jars, often available from hotels or restaurants, are particularly desirable since they are easy to arrange, and, placed upright, can accommodate fairly tall plants.

Terrariums can be easily made. References listed on pages 62 to 64 suggest many types and meth-

panes A, B, C, and D together at (1), (2), and (3). Attach half the width of another short piece at (4), leaving the other half free. To help in placing the tape straight on the glass, crease each piece lengthwise, through the middle, folding it sticky-side-out. *Rub the tape hard.* Slightly warming both glass and tape will help to make the tape adhere firmly.

Stand the four taped pieces of glass on edge and fold them into a rectangle. Fasten (4) to the free edge of A. Adjust the four sides so that the ends of A and C are inside the edges of B and D.

Turn the terrarium upside down so that it stands on the projecting ends of B and D. *Before* you put one of the remaining pieces of glass in place to serve as the bottom of the terrarium, attach half-widths of tape to all four edges (as in E.) *Then* place it, fasten it securely to the sides, and turn the terrarium upright, ready for the cover.

A tab may be placed at the center of the free edge of the cover so that it may be lifted easily. Attach a little less than ½ inch of the 3-inch piece of tape to the underside of the cover glass, at the center of one long side. Fold the tape, and attach an equal length of the other end to the upper side of the glass, as shown in F. Bind the edge on which the tab has been placed with a piece of tape in the middle of which a longitudinal slit has been cut long enough to allow the tab to be slipped through (G and H).

Attach a half-width of tape to the hinge-edge of the cover glass. Put the cover in place so that it rests on the top edges of A and C, and press down the free edge of the tape to form a hinge. The hinge may be reinforced by adding another strip of tape on the inside.

Use the last long piece of tape to bind the upper edge of the side upon which the free edge of the cover rests. The remaining short piece of tape, split lengthwise, should be used to cover the top edges of B and D. Fold the extra width down over the *outside* of B and D. For safe handling, all exposed edges of glass should be similarly protected.

Terrariums so made are not always water-tight. A tray, a piece of board or a shallow pan, placed underneath, will protect the supporting surface.

**Plans and Preparations**

Terrariums planned, constructed, and maintained by children, with their teacher's guidance and help where it is needed, unquestionably yield the greatest educational return. Many sources are available where children can gain information suited to their interests and ability—information such as is summarized in this Leaflet. Some are mentioned in the reference lists on pages 62 to 64.

Fall is a good time to start, although terrariums can be made in

any season, even in winter.

**Types of Terrariums.** The first question to be decided is what kind of a "habitat" is to be represented so that suitable conditions may be arranged and suitable plants and animals chosen. Field trips can introduce and help to solve this problem by providing an opportunity to note the various environmental types in the vicinity of the school. It is best, usually, to choose a familiar type first—one where plants and animals can be observed outdoors, and growing or living conditions noted, to be reproduced so far as possible in the terrarium.

A first grade teacher reported as an exceedingly satisfactory terrarium (though not the prettiest) one planted simply with a piece of sod from the school grounds, cut to fit and placed on the usual inch or so of clean gravel. (An area of about 1 square foot is a good size.) Grass grew quickly, and the children enjoyed "mowing" it with scissors, and discovering new things that grew or appeared. Similar terrariums housing a bit of woodland "floor," an oblong of moist marsh or streamside soil, a piece of old-field sod, or other "habitats" that can be lifted essentially in one piece are equally rewarding.

Terrariums designed to produce an attractive bit of landscape are more decorative. Woodland terrariums probably are most common, but a bit of meadow or field, of marsh or bog, or of desert is not difficult to achieve.

A survey of available locations in the room may help to determine the type as well as the size and shape of the terrarium. Temperature and light are important. Daytime temperatures of about 75° F. produce good results. Night temperatures should not usually fall much below 50°. Plants of various kinds require varying amounts of sunlight. Woodland plants live well in semi-shade, but desert plants do best in warm, sunny locations. Most terrariums thrive in any well-lighted place with not more than an hour or two of sunlight each day. Morning sunlight is preferable—a north or east window is ideal. Once the best possible spot is chosen, the terrarium should be left in its place except as seasonal changes alter conditions.

The type chosen, the next step is to assemble the needed materials: a container and a cover for it; soil (best from the chosen habitat); gravel or cinders for drainage and possibly a few pieces of charcoal to absorb odors; plants (small plants, of kinds that normally grow in the habitat to be reproduced); suitable animals, if animals are wanted; bits of appropriate "interest" materials such as mossy stones or pieces of wood, or small rocks. Always the teacher should emphasize the need to choose plants that are not rare, and animals that can be made comfortable, and then to collect

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only as much of any material as can be used.

For a woodland terrarium, put in first an inch or so of washed sand, coarse gravel, or even cinders or pebbles. You may add a few pieces of charcoal (pure charcoal, not the treated kind often sold for picnic fires) but this is not necessary. Next add a layer of loose rich humus from a woodland floor. How thick these two layers are depends somewhat on the size of the terrarium—about one fourth its height is a suggestion. Small woodland plants from the same or a similar woodland are desirable.

For a bog or marsh terrarium, the first (drainage) layer should slope from a height of 4 inches at one end to about 1 inch at the other. Soil from the bog or marsh should be added. A water-tight container is needed, since about 2 inches of water will be added to the soil. Plants that grow naturally in such environments—plants that require much moisture—should be chosen.

A desert terrarium requires a layer of coarse gravel covered with sand. The lower layer should be moist, the upper layer dry. Dry-area plants, such as cacti and many Sedums, are appropriate choices.

A drainage layer, covered with soil suited to the needs of the plants, is a general rule whatever the type of terrarium. Thus a terrarium of garden plants needs a drainage layer and one of good garden soil, or of potting soil from a florist's or some other commercial source.

**A "Pond" or "Lake."** Two reasons to include a container of water in a terrarium are: (1) to add to the interest and attractiveness and (2) to furnish the water needed by animal inhabitants. The container should be inconspicuous—glass, a dull-colored rubber or composition soap dish or a dish of similar material that will not rust or otherwise deteriorate. It may be sunk to its rim in the soil. A thin layer of sand in the bottom lends realism. Usually the "pond" should be shallow, but its size will depend on its purpose. If it is to be used by turtles, frogs, or salamanders, it should be large and deep enough for them to swim in. Frogs and most salamanders get at least part of their oxygen through their skins which must be kept moist. Some turtles can eat only underwater. Always the water should be clean.

**A Cover.** Most terrariums should have a tight glass cover which can be raised, lowered, or moved aside to admit varying quantities of air and to maintain a suitable humidity level. A screen cover is usually preferred for a desert or other dry-area terrarium.

The cover generally is kept closed. Enough air usually is admitted. A tight glass cover may need to be lifted or opened slightly for a few minutes each day. The plants in the terrarium should ap-

pear fresh, but mold or other fungi may develop if the air is too warm and humid.

**Plants and Planting.** A carefully planted terrarium can be a beautiful bit of nature that will give pleasure for many months. A band of moss on edge with the green side next to the glass may be placed around the base of the terrarium before the soil is put in. A soil surface of ups-and-downs makes possible a more interesting arrangement than a flat surface. Moisten the soil slightly before you begin planting. Put in the larger plants first, toward the back of the terrarium. Spread the roots carefully, cover them well, and press the soil closely around the base of the plants. *Do not overcrowd*—they will grow.

Small specimens of plants that grow slowly or never grow tall are the best choices for most terrariums. Plants selected to live together should have similar requirements as to soil, light, temperature, and moisture. In a woodland terrarium, mosses, small ferns, aromatic wintergreen, partridge-berry, violets, hepatica, tree seedlings of various kinds, and many other plants are useful. Mosses make an attractive green carpet among the larger plants. Stones or pieces of wood covered with mosses or gray-green lichens add interest, as do pieces of bark, nuts, a few brown leaves, a colorful fungus or two, or a rock ledge around the pool. Many liverworts grow throughout the winter months—they do best in a mixture of sand, loam, and scrapings from charred wood. Most fungi soon deteriorate, but are pretty while they last.

Cacti for desert terrariums may be planted in small pots of soil, which are then sunk into the sand so as to be completely hidden.

For a terrarium of cultivated plants, a visit to a florist shop or a variety store will yield many suitable kinds, among them croton, grape ivy, small-leaved English ivy, several varieties of ferns, Fittonia, Philodendron, and Sanseveria. Sedums of various kinds and some Begonias are useful, too.

Tiny bulbs, such as oxalis, may provide a "surprise," if tucked here and there among other plants.

When you have finished planting, sprinkle the terrarium until all the soil is moist, but not wet. A bulb spray or a clothes sprinkler is best for this. Usually no more water will be needed for a month or so. Moisture given off by the plants will condense on the cover and drop back to the soil. Water the plants only when they begin to look dry or when condensation on the glass is very slight—then moisten them thoroughly, but do not overdo it. Open the cover a little for a while if the terrarium appears too wet.

Occasionally you will need to replace some plant to keep the terrarium pretty. Pick off dead leaves, and prune plants when

they need it.

On extremely cold nights and weekends, most schoolroom terrariums need some protection from low temperatures. A box or carton, larger than the terrarium, in which a thick layer of crushed newspaper may be packed under, around, and over it usually will suffice.

**Animals for Terrariums.** For ordinary terrariums, only small animals are suitable, and only a few kinds make successful permanent residents. Passing guests are best; never enough to overcrowd their home. It is difficult to keep a terrarium neat and attractive if it shelters an active animal or two, but animals do add to the interest. Besides food and water, most need a resting or hiding place—perhaps a branch, a stone, a piece of wood, or some moss.

Small turtles, toads, and some kinds of frogs and salamanders can live comfortably in a woodland terrarium provided with a pool large enough for them to swim in. Bog or marsh terrariums make suitable homes for the same kinds of animals. But toads, especially, are hard on the plants and the general cleanliness of the terrarium, though they feed willingly and sometimes may be watched while they shed (and eat) their thin outer epidermis. Salamanders hide much of the time. Turtles need considerable sun. Two or three land snails provide an opportunity for children to see how these animals differ from water snails. The white-lipped snails frequently make nests (in small cavities often visible through the glass walls) and lay their pearly white eggs where watchers can see them develop.

Small snakes (be sure they are harmless) can be made comfortable in a dry-ground terrarium. They need considerable sunlight.

**Notes and Some Studies**

Terrariums and aquariums provide settings for many similar experiences that can contribute to science learnings. Many of the studies suggested on pages 13 to 21 need little adaptation to be equally useful as guides to terrarium observations. Evaporation and condensation are phenomena easily observed in both. So also are the life histories of animals and their ways of getting food and shelter; the variety of plants and differences in their ways of growth; the relationships of living things to water, light, heat, and air.

To add interest and value, make a small map, labelled to identify plants or to call attention to animals or other interesting features. Or, set up a miniature nature trail in the terrarium; you may use brief labels, or small numbered "flags" and an accompanying "Terrarium Guidebook."

To have both aquariums and terrariums in a classroom provides many opportunities to compare the kinds and ways of life of creatures that live in water and those that live on land.

*This box turtle has been removed from its cage to receive a grasshopper for a meal*

## Animal Pets and Guests

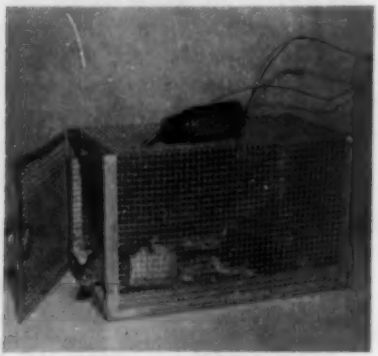
LIVING animals are an important part of a child's world. Getting acquainted with them at first hand, coming to understand their ways and their needs, learning to deal with them, all are enriching experiences. Enjoyment of pets, at home or at school, is almost universal.

At school, pets can play a large part in many learning situations, particularly if children are led to take all possible responsibility for them, and encouraged to learn about them by watching, by reading, and by other means open to them. The following accounts of pets in Mrs. Perelli's kindergarten illustrate well how understanding and appreciation may grow out of direct experiences with living things.

### Animal Visitors in Kindergarten

**A Pet Rat.** Timothy Rat (a hooded rat) was in his cage when the children arrived at school. They crowded around anxious to see and to touch. He was the first pet of the year—the class needed training in animal care. We talked about being kind to the rat, so that he would be friendly. We decided that loud noises and sudden movements frightened him and that it would not be comfortable for him if we all tried to pick him up. At my suggestion the children

sat in a tight circle, leaving no room for the rat to squeeze through. Then I put Timothy in the circle. The children sat quietly making no move to touch the rat. He ran from one to another climbing over them. The children noticed that he was warm and furry. They watched his body move as he breathed and noticed how much his paws, with their scratchy claws, were like their own hands. They were delighted when he held a piece of cracker in his paws to eat. When we put Timothy into his cage, the children noticed the things provided for his health and comfort. He had water in a bottle, milk, and food. Sawdust on the cage floor absorbed his droppings and he had a tin can filled with tissues for a bed. Timothy curled up with his tail over his back and went to sleep in the can. The kindergarten concluded that even a rat must have peace and privacy.



*Timothy Rat*
*Gnawing animals need gnaw-proof cages*

**Tabitha, the Cat.** Timothy set the pattern for care of pets in the classroom. A cat was the next visitor. She did not come in a cage and so the class had a chance to provide for her needs—a dish of milk and a box of earth. The children noticed that, like the rat, she was warm and furry and that her body moved as she breathed. The children felt their own chests and "tummies" move as they breathed and noticed that they too were warm. "But we're not furry," said Richard. "We've got hair though." They all stroked their hair thoughtfully. They were beginning to realize that they were similar in some ways to cats and rats. We opened the cat's mouth and noticed the long canines so suited to tearing flesh. The children decided her sharp claws were good tools for catching mice, and were fascinated by the way they could be sheathed when not in use. Here is their list of differences between themselves and the cat.

1. She could pull in her fingernails.
2. She could switch her tail.
3. She could lick her back and stomach.
4. She could make the black parts of her eyes like slits instead of dots.
5. She always walked on tip toes.
6. She could move her ears.

**Ebony, the Rabbit.** A rabbit was studied in much the same way.

We watched the way his teeth nibbled and grated his food—not tearing it as the cat did. The children remarked on his long back feet and on the way he hopped. They found that he was hard to approach, because of the position of his eyes. We discussed how this would help a wild animal escape from those who wanted to eat him.

**A Visit to a Bird.** One of the other grades had a parrakeet in school, and the kindergarten paid him a visit. He was very tame and the children were able to hold him. They noticed that he was warm, but that he had feathers instead of fur. He had no teeth in his beak and he had wings instead of front legs. They decided that a parrakeet was a different kind of animal from the rat and the cat. At this point I told them that the rat and cat and most of the creatures they usually called animals were all *mammals*. The parrakeet was a *bird*, they knew.

**Our First Snake.** John came down from the fifth grade carrying a jar. Someone called out, "Teacher, he has a snake," and from all directions the class came running. "Is it poisonous? Will it bite?" "What kind is it?" "She's going to pick it up." "Can I pick it up, too?" "Maybe I could touch his tail." Soon every child in the class had touched the snake and many had held it. They remarked on its pretty coloring—it was a red-bellied snake. John did not want the snake again, so the class decided to keep it as a pet. It was small, so we made a home for it from a wooden cigar box. We removed part of one end and tacked window screening securely over the hole. This we decided would allow the air to circulate through the box. We replaced the lid with a glass cover, so that we could watch the snake. We covered the bottom of the box with clean sand and put in a dish of water. The children found that the snake could be either stiff or "loose." Curled up, it was relaxed; but it could stretch itself out straight, even bridging considerable distances with its stiffened body. We kept the snake until the end of the week. It would not eat, and so on Friday we took it to the woods and released it. After this event a new snake was brought to school almost every day. We kept some of them for short periods, but the children readily understood that it was fairer to the snakes to free them after we had watched them. On all the snakes we noticed the scaly skin, the lack of eyelids, and the forked tongue. The class noticed the "hole" in the snake's lips that enabled it to stick out its tongue without opening its jaws. They noticed that the snakes could not move very well on the slippery linoleum counter top and concluded that they needed a rough surface to push against. They also observed the patterns of the snake's tracks in the sand.

**Turtles, Big and Little.** Turtles made longer visits to the schoolroom, because they could be more easily fed and housed. The children brought several different kinds of turtles. We used reference books to find their names and to learn how to take care of them. Most of these turtles had shells less than 1½ inches across and lived mainly in water. They were placed in a wide bowl containing less than an inch of water. Rocks were placed in the bowl to provide a dry place for sunning. Feeding the turtles was no problem as special turtle food can be purchased. The children discovered that these turtles had to eat in water. This was not true of Clem, the big wood turtle. He roamed loose in the class room for a week. He did not eat in water but liked to have a pan of water available. The children liked to hear the bump of his heavy shell on the floor as he took each step. They felt the hardness of the shell and watched the way Clem would retreat from danger by pulling his head and limbs into the spare places in his shell. They noticed that his neck moved as he breathed and concluded that there wasn't room for his lungs to expand inside his shell. They felt the scratchiness of his sharp claws as he walked on their laps and they found that, unlike the snakes, he could close his eyes. They decided that his head looked rather like a snake's and that his scaly skin was very snake-like. This class was much interested in which animals had backbones. They had difficulty in deciding whether Clem had a backbone like a snake or whether his shell took its place as the shell of the crayfish did. An empty turtle shell soon settled the question, for the children easily observed the spine inside the shell.

**Frogs, Toads, and Salamanders.** The aquariums and terrariums provided temporary homes for several kinds of amphibian visitors. The kindergarten loved the sound of the word *amphibian* and used it at every opportunity. They decided that adult amphibians were "chin breathers" after observing frogs, toads, and salamanders pumping air into their lungs by expanding and contracting their mouth cavities. The children held different amphibians for short periods of time, and noticed the warty skin of the toads and the damp smooth skin of the frogs and salamanders. We discussed the fact that too much handling of amphibians in warm hands kills them because they get some of their oxygen through the skin but they can do this only when the skin is moist. The children noticed that none of these amphibians had claws. The land salamanders' feet looked like tiny hands without fingernails. They observed the way the webs on the feet of frogs help them to swim and the way the frog's large hind feet help him to jump.

**Insects and Other Small Animals.** Many smaller animals without backbones were kept in the classroom during the year. They included a crayfish that shed its skin. The children decided it would be uncomfortable if their own skin did not grow but got tighter and tighter until it split. The children brought many insects to school in cans and jars, among them bees, wasps, ants, beetles, aphids, grasshoppers, leaf hoppers, moths, and butterflies. Tent caterpillars were great favorites and were easily obtained. Near the end of the school year the children saw their pets turn from caterpillars into pupae. On a field trip we found a dead looking cocoon attached to a twig. We pinned the twig to the window frame between the glass and the screen. If we had kept it inside, the heat might have dried the cocoon and killed the moth. The class did not really believe that it was alive until the morning that the huge Cecropia moth crawled out. Its massive wings were so folded and crumpled that the children were sure it could never fly. All day long it pumped and stretched its wings. By afternoon its full beauty could be seen. Next day it flew away. In June, Dorothy brought a dainty Luna moth to school. We watched it lay its eggs and then released it. She hopes to raise the larvae.

**The Kindergarten Zoo.** All the animals brought into the room were left where the children could easily observe them. Plenty of time was allowed to see the form and watch the habits of each creature. The interest in these classroom animals soon spread to the rest of the school. Even high-school students visited the room. The kindergarten decided to have a zoo for the older children. They decorated the room with appropriate pictures, sent out invitations, and collected more than forty live animals. All were easily found in the community by the children and ranged from earthworms, toads, and snakes, to roosters, rabbits, and parrakeets. The only restriction was that the animals must be caged or in a can or bottle. The kindergarten pupils were zoo keepers and answered the other children's questions. The ease with which they accomplished this was proof of the science they had learned through direct experience.—*Doreen Perelli*

**Wild Mammal Pets**

We had two mammal pets in our room (grades 1 to 4) this year. One was a flying squirrel we were allowed to care for while her owner was on vacation. From the moment of her arrival, Sally aroused intense interest. She had a large cage, in the bottom of which were layers of paper and an old rag, which she usually managed to pull under the papers, and in which she slept. Since flying squirrels are nocturnal, we had

to "get her up" to see her or to clean and rearrange her cage. Cleaning the cage was difficult—the top had to be lifted off, and Sally held in someone's hand while the necessary work was done. If she was awake, she gave us a merry chase; it was impossible to get her in hand if she did not want to come out.

After some discussion of the problem, we decided to offer her a "house" to sleep in. We made it by cutting a hole big enough for a door in one side of a cottage-cheese box. Sally moved in. Thereafter we could take the "house" out while the cage was being cleaned, remove the cover, and carry Sally, asleep in her box, around the room for the children to see and to pet. The cover and a hand over the entrance hole prevented her escape if she became restless.

Flying squirrels are very appealing—perhaps the large eyes and the soft fur are good reasons. The children were fond of Sally. They fed and watered her, changed and cleaned her cage, and hated to see her leave at the end of the four weeks she was with us.

*Photo by Wilson Clark*

*A Pet Chipmunk*

Our other pet was a young chipmunk, which had been in captivity for two weeks. He wasn't tame, but he didn't bite. The friend who gave him to me had not provided him with a nest box or "house," inside his cage, which may be one reason he had remained so wild. I took him to school and carried him in my pocket during school time. The children knew he was there, and that my purpose in carrying him was to accustom him to being handled and to schoolroom noises, but, most of all, to accustom him to me. I took him out occasionally, and perhaps once a day, let children hold him for a short time. So long as they put a hand over his head, he was quiet, seeming, like the proverbial ostrich, to feel safer with his eyes hidden. The children enjoyed this, of course. At every opportunity they brought visitors and parents to see the chipmunk. They named him Rumpelstiltskin, Rumply for short.

I have had several chipmunk pets. These things I have learned: Females are more tractable than males. Chipmunks become better pets if one finds them while their eyes are still closed. At first, Pablum and milk are good foods, but the animals soon graduate to berries, watermelon, and other juicy fruits, maple "seeds," nuts, peanut butter, and many other foods—they are nearly omnivorous. They

need a constant supply of clean, fresh water. They may become ill-tempered as they grow older. If they are provided with a "house," they are much easier to handle. They can take a lot of handling, and petting seems to increase their tameness. Individuals differ—some just naturally make better pets than others.—*Patricia Adams*

### Shall We Have Pets at School?

Among the questions to be answered by teachers and their pupils are these:

Do we want pets? Keeping animals alive and well in captivity in a schoolroom is a challenge. Unless the children—and their teacher, too—have a real interest in the project, and are willing to undertake the daily chores connected with the proper care of living things, it is best either to omit this type of experience, or to take modest first steps by choosing easy-to-care-for pets for short-period visits.

Have we room for pets? Almost certainly, for some pets. Insects, for example, are fun to watch and easy to keep. Not much room is required for a succession of temporary pets, especially if small animals are chosen.

What can we learn by keeping pets? It takes thought and planning by both teacher and pupils to make the presence of living things yield maximum educational values, but even a few experiences are almost certain to show that living things offer unmatched opportunities for learning, well worth the time and the effort involved.

Can we have pets and yet keep our room neat and attractive?

What kinds of pets can we make comfortable?

Answers to these and perhaps other questions are a necessary part of teacher-pupil planning for animal visitors.

### Some General Suggestions

Keep ready at all times a small collection of containers and cages or materials from which to improvise. Aquariums or terrariums will accommodate many pets. A few cages, of various types and sizes, are enough. A friendly custodian is a big help in such matters.

By agreement with the children, choose pets of suitable kind and size that can be kept comfortable and well.

In New York State, as in most States, it is lawful to capture or to keep certain wild animals in captivity only under specified conditions. Find out what the laws are, and follow them scrupulously. A local game warden will be a help.

When a new animal is brought in, take time to discuss it with the class and to plan for its care. When it has been properly housed and comfortably cared for, give it time to recover from fright or nervousness, and to rest.

Decide with the children how long a given pet is to stay at school and what is to be done with it at

the close of its visit. In general, short-period guests are best; only comparatively few animals except those accustomed to captive life are suited to long-time residence. Educational value is not always directly proportional to the length of stay; interest and learning usually are greatest in the first few days. By common agreement and with the help of the children, creatures that cannot be adequately cared for at school should be returned, alive and well, to their natural (or former) environments.

Label each cage with the name of the animal. A biological fact or two may be added, or the answer to a usual question, a correction of a common misconception, or a direction for observation. A card, held on a simple easel or other support, is enough, although attractive "interest corners" such as that illustrated on page 29 may be arranged.

### Cages and Other Animal Homes

With a few simple, easily obtained materials and a little ingenuity, suitable cages can easily be provided for prospective schoolroom pets. Glass bottles or jars, "tin" or cardboard cans, odd bits of sheet metal, pieces of glass and of copper or galvanized wire screening, hardware cloth of varying mesh, cheesecloth or other open-meshed material, pans of various shapes and sizes, plastic or wooden boxes or cardboard cartons are only a few of the materials. Aquariums or terrariums may be used.

Several easily made types of insect cages are illustrated on page 49. You can follow one or another of these designs for cages for many kinds of small animals. Desirable variations are suggested in the discussions on pages 47 to 52. Pet books and other references on the keeping of captive animals contain plans for many special types of cages for particular kinds of animals.

Type, design, and material are far less important than that the occupant or occupants thrive and are comfortable. A good cage should, in addition, permit easy, convenient care. Here is a check-list of points to consider:

- Is there room enough for the animal or animals to move about?
- Does the cage provide conditions as nearly like those of the natural home of the occupant as is possible?
- Is there a comfortable place for the animal to sit, lie, or perch?
- Is there a shelter in which it can hide or sleep?
- Is the cage well ventilated without being drafty?
- Is it located where light and temperature are suitable?
- Does the animal have access to plenty of clean food and fresh water?

From the caretaker's standpoint: Is the cage secure? (Escapes are always disturbing to

everyone and sometimes fatal to the pet.) Is it easily cleaned? (The bottom may be removable and covered with newspaper or other absorptive material that may be destroyed; or it may be of wire mesh of suitable size so that droppings will fall through onto a pan of sawdust, sand, or other disposable material.) Is there a way to reach into the cage easily without permitting its occupant to escape, to clean it, provide food or water, and, if necessary, to remove the animal? (A door or a hinged top or side usually are easy to arrange.)

### General Care of Animals

Regardless of the kind of captive animal, scrupulous cleanliness of its cage, plenty of clean, fresh water for creatures that need it, enough fresh food of the right kinds, and regular daily attention are necessities.

Regular feeding times and varied diet are best. Many wild animals must become accustomed to eat under new conditions, especially when unaccustomed foods are offered. Some may refuse to eat—these should be liberated after a short stay in the classroom.

Uneaten food should be removed before it can spoil. Dead animals, decaying plants, and any other material likely to endanger the health or comfort of the animals, should also be removed.

### Some Animals to Choose From

Nearly every group of animals includes some species that can be kept alive for study in the schoolroom. Some have been mentioned in the sections on aquariums and terrariums. Only a few more are discussed here, with particular attention to their general care. Pet books suggest many others and contain helpful detailed directions for keeping them.

Once you have a few pets, they will provide a fascinating succession of activities to watch. Class discussions and good books suggest special things to look for.

**Insects.** Fall and spring are particularly good times for insect visitors. In the fall, crickets may "fiddle"; a praying mantis may stalk and eat a grasshopper; a ladybird beetle may feast on aphids; or a caterpillar may make a chrysalis or spin a cocoon. In the spring, emergence from pupation, the laying and hatching of eggs, and the feeding and growth of young insects are only a few of the possible things to see.

Insects are easy to get and simple to keep. Terrariums (preferably covered with screen rather than glass, to avoid excessive moisture), make good cages for most insects. Several types of cages are illustrated on page 49. Glass jars or bottles are useful, too. Jars or other cages may be covered with screen, mosquito netting, or other coarse-meshed cloth, or with metal

covers in which several small holes have been punched.

Soil with plants growing in it makes a good floor. For many insects the plants serve as food, resting place, and cover. And the soil, if it is moist and 3 inches or so deep, provides a place: where grasshoppers or crickets may lay their eggs; where some kinds of caterpillars may find a pupating place; or, where ants or other burrowers may make themselves at home. The soil also forms a good support for a narrow-necked bottle of water in which pieces of food plants can be kept fresh for caterpillars and other leaf-eaters. The bottle should be plugged if necessary to prevent insects from drowning.

Most common insects like some sunlight and a shady place to go when they become too warm. Lightly sprinkling the inside walls of the cage and the plants in it provides enough water. A flat stone makes a hiding place for crickets and other ground-dwellers.

Leaf-eaters, such as caterpillars, should have fresh leaves of kinds upon which they are known to feed—usually the kind upon which they are found. Crickets and grasshoppers eat grass and other fresh plant parts, bread crumbs, and bits of fruit.

When caterpillars are ready to pupate, some spin cocoons, some form chrysalids, and some go into the ground. Those that spin cocoons or form chrysalids above ground usually fasten them to the walls of the cage, to plants, or to leafy twigs, or make them inside leaves that drop to the floor. Finished cocoons or chrysalids (except those of Monarch butterflies which transform to adults in early fall) may or may not be removed from the cage, but should be kept until spring in a cool place that is neither thoroughly dry nor damp enough for mold to form. Out-of-doors, in a sheltered place is best; fastened between a window and its screen, or even sewed to the screen, is an excellent way to keep them. The adult insects then emerge at their normal time, and children can have the satisfaction of freeing them, knowing that they have a fair chance to survive and to produce a new generation of caterpillars.

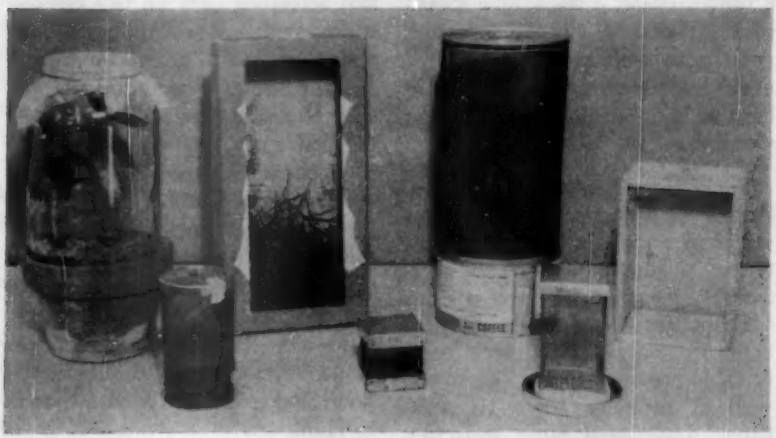
Much more could be said about keeping and studying insects. Why not set up an insect "tourist camp" and watch these small animals and their interesting ways, as varied as their colors, shapes, and sizes?

**Earthworms.** A covered glass jar, about 2-quart size, filled with rich, moist soil to within 3 or 4 inches of the top, makes a good container for earthworms. If the jar is kept covered with dark paper most of the time, the worms will usually stay close to the walls, where their work can easily be observed. Earthworm activities are interesting, and the worms are good food for many other animals.

**Spiders and Some Other Invertebrates.** Nearly every child knows how many kinds of small creatures may be found under a board or a flat stone in a moist place on the ground—spiders, ants, beetles, sowbugs, centipedes, millipedes, snails, and others. A terrarium with a surface a square foot or more in area is a good place to establish a community of such creatures. Use a layer of gravel or sand, a layer of moist soil, a large, flat stone, and perhaps a few pieces of sod. The creatures will "set up housekeeping," and provide many interesting observations.

The spiders found in such places usually do not spin webs. For web-makers, use a tall container, large enough for a layer of sand or pebbles, and one of sod, a tall plant, and a bushy branch or weed-top. Keep the soil moist, but not wet. Put in 1 or 2 spiders and cover the container. Feed the spiders live flies or other insects. How webs are fastened in place, how spiders eat, and where they spend their time are only a few of the things that can be observed.

**Frogs, Toads, and Salamanders.** Of the smaller New York State salamanders (8 inches or less in length), the vermilion-spotted newt is the only one suited to live as an adult in an aquarium, and even it needs a dry place where it can climb out of water. Other adult salamanders and adult frogs and toads kept in captivity are much more comfortable (except during their breeding season) in a moist, mossy terrarium that contains a dish of water large enough for them to swim or sit in. Tight



*Some Insect Cages*
*Window screening was used in all cages except the two at the ends. The bottle at the left is bottomless; the chalk-box has a glass front*

screen or glass covers are needed to prevent escapes. A "cave" or other hiding place under moss or a piece of wood or stone is much used by many amphibians. Tadpoles, hatched in an aquarium (page 13) should be given similar surroundings as the time approaches for them to leave the water. The little red eft, the immature, land stage of the vermilion-spotted newt, is a favorite terrarium animal.

Cleanliness and coolness are important for these creatures. All the adults are animal-eaters, as are the young salamanders. Most will eat a wide variety of food (page 25). Large individuals may eat smaller ones. They are accustomed to living food; therefore, they are more likely to eat bits of liver or beef if the meat is "wiggled" on the end of a broom straw, a stem, or a toothpick. Twice a week is often enough to feed most amphibians; even less frequently if they are kept at low, but not freezing, temperatures.

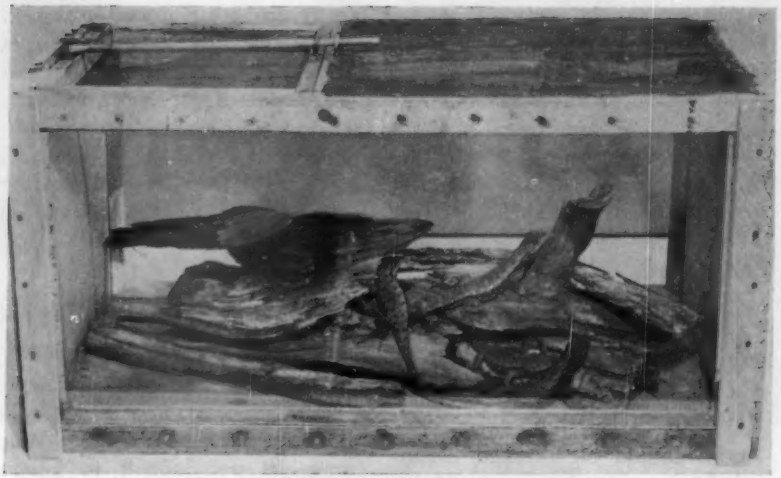
**Snakes and Other Reptiles.** Reptiles are among the easiest vertebrate animals to keep in captivity, since they can live comfortably for relatively long periods without food, especially if kept cool. In general, they need comfortable temperatures (most do well at ordinary room temperatures; some need more warmth), well-ventilated but not drafty cages, and usually a hiding place.

For schoolroom study, only harmless snakes should be caught or kept captive. In some parts of New York State, there are copperheads and rattlesnakes. Learn where they are found, and how to recognize and avoid them.

Some nonpoisonous species make better pets than others. Water snakes may be vicious; garter snakes are satisfactory, although they often give off an unpleasant-smelling liquid when handled. Milk snakes, red-bellied snakes, ring-necked snakes, green snakes, and black snakes are among those that usually make good pets.

A screen-topped terrarium may serve as a cage, but a snake cage needs to be tight, without a crack or crevice through which the animal can squeeze. A wooden box, big enough to allow free movement, with one or two glass sides, and screening only on top (so the snake will not rub off its face scales) makes a satisfactory cage. A tight-fitting, hinged top permits easy cleaning, feeding, and watering. A smooth, well-painted bottom is excellent, but sand or fine gravel may be used. Snakes in nature live in many situations, but in captivity they do best under desert conditions. They need water, enough for bathing and drinking; a place to hide—a piece of board, bark or stone, supported a little above the floor; and many like a bare branch to climb on.

Foods differ with the size and kind of snake. Small snakes may be fed small earthworms, insects



*A Comfortable Cage for Lizards—or Snakes*
*The front and back are glass; the ends, wood; the top, with hinged door, of screen. An electric lamp may be used above the top for added warmth*

and their larvae, tiny fish, tadpoles, or salamanders, or bits of chopped meat or fish. Larger snakes will eat larger pieces of the same sorts of food, and bigger animals, including live or freshly-killed mice or rats, and sometimes other snakes. Insect-eaters need more frequent feeding than others.

Children usually need to be taught how to hold a snake—its body should be well supported, not held dangling between a finger and a thumb.

Mrs. Adams mentioned some of the learnings that resulted from acquaintance with her pet snake, King: "We, and everyone else in our school, have watched him eat, and learned that snakes eat other live animals. The children found snakes not so frightening as they had been led to believe. They watched him shed his "skin," having noticed the "milky eyes" that precede that event. They gained in responsibility as they cared for him through the year."

Turtles can live well in a fairly high-walled, open box, its bottom covered with sand in which is sunk a large pan of water. A layer of gravel in the water pan, and a few rocks to climb on are good additions. Small turtles make the best pets. Snapping turtles should be avoided—large ones can bite hard. Some kinds of turtles spend much time in the water; some feed only in water. Suggested foods are listed on page 25; feeding once or twice a week is enough. Turtles need sunlight, but should also have a shady place to retire to. It is best

not to keep them captive long. In New York State, permission to keep wood and box turtles as permanent pets must be obtained from the State Department of Conservation.

Lizards and American chameleons occasionally find their way into schoolrooms. Most pet books give directions for their care.

**Birds.** A permit is needed to keep wild birds of protected species in captivity, and permission is difficult to obtain unless one is doing research. State game regulations should be checked before any birds or fur-bearers are kept in captivity. Several species not protected by law in New York State may be kept as caged birds: crows, grackles, kingfishers, starlings, house (English) sparrows, Cooper's and sharp-shinned hawks, great horned owls, and goshawks. Adult birds usually are extremely hard to keep, and to raise young birds requires great patience and persistence. More can generally be gained by outdoor study of free wild birds, especially when it can be done by means of feeding stations or bird houses outside the schoolroom windows.

Canaries and parrakeets are satisfactory schoolroom pets, and a hen with a nest of eggs to hatch or a brood of young chicks is a most rewarding visitor. Help on the care of all these is easy to get.

**Mammals.** Probably more "home" pets are mammals than are members of any other animal group. In most elementary classrooms, pet animals, at home with children and accustomed to captivity, are wise choices for first schoolroom experiences with mammals. That such animals are interesting to youngsters and that living with them even briefly provides excellent opportunities for learning were illustrated by the response of Mrs. Perelli's kindergarten children, told on pages 39 to 43.

Some wild mammals also make satisfactory pets; Mrs. Adams tells of two (pages 43 to 45). Wild mammals are difficult to keep—adults do not tame easily, and young animals require frequent, meticulous care, although they are more likely to become good pets. Except for those foundlings, strays, and others sometimes brought to schoolrooms, cared for briefly, and then released, captive wild mammals should probably be few—limited to classrooms where the teacher or some child is unusually interested and adept in caring for them. State permits are required to keep certain mammals captive.

Most mammals need careful, daily care, even over week-ends. So, short period classroom visits generally are desirable. Requirements for food, shelter, and general care vary with different kinds of animals. Books about pets, such as those listed on pages 62 to 64, should be consulted if other-than-familiar mammals are to be kept in the classroom.

*Photo by Douglas Payne*

*A kindergarten group grew sweet-potato vines first; then a white potato (right) "to see if they would be alike."*

## Plants in the Classroom

PLANTS are "magicians with the power to turn an unattractive classroom into a beautiful and pleasant place to work. . . . Plants are assets in other ways, too. They are good visual aids, capable of greatly enhancing lessons in English, geography, history, social studies, and science." So wrote Ellen Eddy Shaw and Margaret Dorward,[1] both of whom spent years at the Brooklyn Botanic Garden teaching boys and girls, and their elders, to grow and enjoy beautiful plants.

Knowledge of plants, their needs, their ways of growth, their history, and their value to man are only part of what children gain by watching, experimenting, and working with plants in the schoolroom. Active participation in caring for thriving, attractive plants, as well as growing plants of their own, brings deep satisfaction and a real sense of accomplishment to most children.

Many teachers are gardeners or fanciers of house plants. It is a pleasure to them to help their pupils make their classrooms "beautiful and pleasant" places to work, and to guide children to greater knowledge and appreciation of plants. For less experienced plant growers, a wealth of de-

[1] In *Selection and Care of Plants in the Classroom*, School Nature League Bulletin, October 1943. (Available from the National Audubon Society, New York City.)

tailed material is available. Some is listed on pages 62 to 64. Libraries can supply more, and expert plant growers usually are glad to give help and guidance. A good book of plant studies on an appropriate grade level is a valuable aid.

In the following paragraphs are suggestions for some things to do. To tell here how to do them is impossible, but those you choose can form the basis of many problem-solving activities.

**Choosing Schoolroom Plants.** Plants differ greatly in their requirements for light, warmth, and humidity. It is important to select kinds that will grow well under the conditions you can give them. Select, too, for variety in such characteristics as form, size, color, and growth habits. Some plants you will choose for round-the-year possessions; others, such as some bulbs, for temporary beauty. Wild plants, temporarily in pots, permit children to see the spring growth of hepaticas, violets, and other wild flowers—their budding, blossoming, and perhaps production of seeds. Choose these wild plants with due regard for conservation. Pot them as early in the spring as they show signs of life; dig them with a ball of earth; and return them or plant them in a suitable place when you no longer need them.

**Plants from Cuttings.** Plants that have grown outdoors during the summer sometimes are small enough and compact enough to make good schoolroom plants. More often, starting new growth from cuttings yields more attractive plants and provides an opportunity for children to make the cuttings, root them, transplant the new plants to properly prepared pots of suitable soil, and care for them. Raising his own plant from a cutting delights almost any child.

**Plants from Seeds.** Classroom gardens have been made in paper cups, ice-cream containers, cheese boxes, egg shells, flower pots, and many other types of containers. Children have learned much from such experiences. What seeds are; how they germinate; how and how fast the seedlings grow; and what conditions are favorable for germination are only a few of the learnings. Marigolds, petunias, nasturtiums, or other flowering plants, started at school, have gone home to be transplanted into gardens; acorns have grown into tiny oak trees (the one shown on page 55 is growing on my hillside.) And many experiments with germinating seeds have provided experiences with "the scientific method." Textbooks, books on the teaching of science, and several of the children's books listed on page 64 suggest numerous simple experiments and ways to study seed germination and the early growth of seedlings.

**Plants from Bulbs.** Even an onion is fascinating to children, when, supported on toothpicks over water in a glass, it develops roots and new green tops. Narcissus bulbs are easy to force indoors, and several other flowers from bulbs can be raised. Instructions are given in several of the references listed on pages 62 to 64.

**Plants from Roots.** The sweet-potato vine in the illustration on page 53 was a project of major importance to an Ithaca kindergarten group. Support the sweet potato with approximately its lower third in water. Not all sweet potatoes will grow; some have been sprayed or heat-treated to preserve them. Look for one with plump, fresh-looking buds. Many books tell how to grow new plants from carrot, beet, or rutabaga roots.

**Soil.** Different kinds of plants need different types of soil. Help children learn about soil mixtures and how to prepare soil for indoor plants.

**Caring for Plants.** Day-by-day care offers still other opportunities to learn about plants, their needs and their ways. All need water; some require more than others; few can survive continued overwatering. Good drainage is important. Plants need air; breaking up the surface soil, now and then when the plant is dry, helps to admit air to the soil. Occasional feeding with a good plant food is necessary. Clean leaves "work" better than dust-covered leaves. Sponge leaves with a damp cloth, spray them, or dust them gently with a soft dry brush. Prune plants or pinch off growing tips to keep them well-shaped. Pick off dead leaves and faded blossoms. Cold-weather protection may be needed at times. A sheet of cardboard or of newspaper between the plant and the window may be enough; or it may be necessary to move plants to a warmer part of the room. Plants to be taken home should be wrapped well in paper to prevent chilling.

*This oak tree, started in March, was set outdoors in July*

Unfortunately, plants may have pests and other troubles; try to discover the cause of plant difficulties. Books and expert plant growers can suggest remedies.

**Woody Plant Flowers.** Many woody-plant flowers besides those of the familiar pussy willow can be made to blossom in the schoolroom well before their normal outdoor time. Willows, poplars, elms, maples, hazel, ash, and many other kinds gathered in late winter, will reward children by putting out not only flowers but new leaves and tender new twigs. *Woodlands in Spring* pointed out many interesting things to see.

The following suggestions for forcing twigs are from an article by Ruth Mosher Place, in the *Michigan Gardener,* February, 1946.

Branches of trees and shrubs, cut in late winter, can be brought to bloom indoors as early as February. A sunny morning is the best time to cut them. A sharp knife is the best tool. Each branch should be selected with careful attention to the shape and later welfare of the plant. Fairly new outside shoots, pliable and faintly green underneath, are the flowering parts of shrubs. In many woody plants, the flower buds are larger than the leaf buds.

It is a good plan to carry a pail of water along to hold the branches as they are gathered. State laws forbid the cutting of certain woody plants and such regulations should be recognized. (For New York State regulations, see *Woodlands in Spring,* the Cornell Rural School Leaflet for Spring 1954.)

In the house it is best to put the cut branches immediately into a large pan of barely lukewarm water. The entire branch, including the tips, should be submerged. When the branches are thoroughly soaked, they may be arranged in vases or jars. Every day or so, the upper ends should be dipped in water to keep them moist.

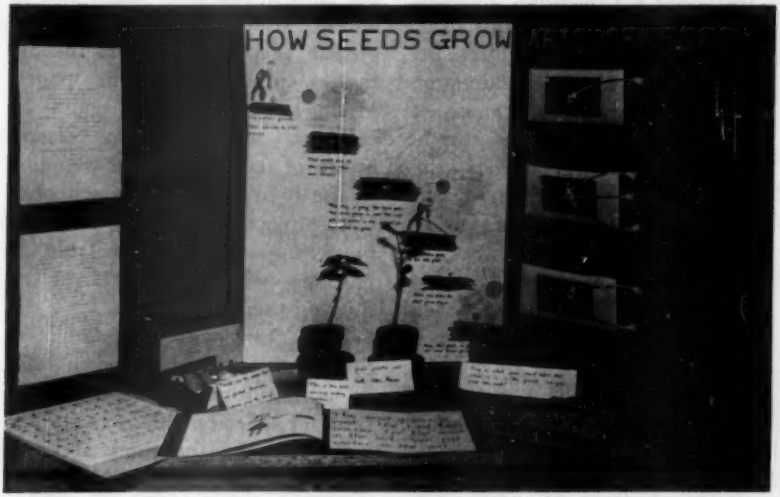
Forsythia, flowering quince, pussy willow, dogwood, apple, flowering peach, cherry, plum, Cornelian cherry, and shadbush, all force well, if cut any time after the middle of January. Lilacs and magnolias are difficult to bring into bloom.

The later the date of cutting the faster branches brought into the house will bloom. Within variable limits the time to be allowed for different kinds of material can be predicted. Here are a few fairly dependable suggestions: Forsythia from 8 to 10 days, if cut late in February; witch hazel, 24 days; dogwood, 28 days; pussy willow, 9 days; flowering quince, 18 days; flowering almond, 21 days; bridal wreath, 18 days; pear, cherry, 30 days; peach, plum, 25 days; magnolia, 25 days; lilacs, 20 days; redbud, 16 days (does not last long after forcing). Hawthorn branches removed in February cannot be forced. They must be cut not more than a month before their habitual blooming time in May to June.

## A Word to Teachers

BECAUSE I have had an opportunity to work closely with Mrs. Perelli, Mrs. Adams, Mrs. Duffany, and the other teachers who have contributed to this Leaflet, I have been able to give to others the benefit of their experiences with living things. If some of you have enjoyed reading these experiences, and perhaps recalling others of your own, wouldn't you like to share ways of doing things and suggestions of things to do in the pages of future Leaflets?

A future Teacher's Leaflet, probably that for Fall 1955, will deal with such topics as *nature exhibits:* the nature corner or science shelf, bulletin board displays, records of science discoveries, calendars of events or happenings in the natural world; *nature and science crafts,* such as leaf prints, plaster casts, dioramas, and the construction of simple equipment primarily for elementary school use; and *study collections:* how to make and keep them. Your notes and photographs (preferably glossy black-and-white prints) and samples of children's work will be much appreciated. Please write to me about things you do that you could share with other teachers. I have much appreciated past letters from users of the Leaflets, and will welcome suggestions for future numbers. *Eva L. Gordon.*




*Lima beans formed the basis of this study*

### Fall Changes

Autumn in New York State offers many illustrations of the adaptations of living things to the seasonal changes that take place year after year in their environment. Plants and animals other than man probably do not "get ready for winter" in the same sense that human beings prepare for the coming of that season. Many, however, show marked changes in activities and ways of life in response to the progressively shorter days and cooler weather of the fall season.

Those changes, but especially the changes in behavior among animals, are the theme of the Fall children's number of the Leaflet.

### Science with Toys

Birthdays, Christmas, visiting relatives, and shopping trips bring toys into the home. Children enjoy their toys, and spend many profitable hours improvising games, experimenting to learn what can be done with their playthings, discovering what makes them "work," and testing the effect of various conditions on their successful operation.

Playing with toys can yield many science learnings. Some of these, children get for themselves; others can easily be developed through schoolroom experiences. So, early in the New Year, while Christmas toys are still new, the Winter Cornell Rural School Leaflet will bring suggestions for using some of them as a basis for science learnings. It will also offer help in making some simple "scientific" toys.

### Summer Nature Explorations

Because of unfortunate delays, *Woodlands in Spring*, the Leaflet for Spring 1954, could not be distributed to the schools in time for use in its season. Probably no loss was ever without at least some small gain. Teachers who requested and have received *Woodlands in Spring* can plan now for its use during the spring of 1955. It should help to develop a "conservation consciousness" in an area where children can have a real part in conserving an important natural resource. Many fall or winter studies could contribute greatly as predecessors to the activities presented in its pages. Much helpful material could be collected and used by classes aware of its content and planning to use it in a springtime school or class project. Copies of *Woodlands in Spring* are still available to teachers who have not yet requested them.

Then, too, with *Woodlands in Spring* waiting to be used in 1955, an opportunity is opened to present a Leaflet on things to do and make and see and think about in summer. The Spring 1955 Leaflet will deal with that subject.

Only a few days before this page was written a letter came to our office from a ten-year-old boy interested in keeping and learning about turtles. Many children have out-of-school nature interests. Perhaps some have made summer nature explorations about which the new Leaflet could tell other boys and girls. The Leaflet author would be delighted to receive (soon) letters concerning, let us say, "My most interesting summer nature discovery." To help others, such letters should tell what the young explorer investigated, how he worked, what he used, and what he learned.

## Where Is New York's Largest American Elm?

The New York State Arborist's Association is sponsoring a contest to locate the largest American Elm now growing in the State. A survey conducted by the American Forestry Association in 1950 reported an American Elm near Trigonia, Blount County, Tennessee to be 24 feet 7 inches in girth at 4½ feet above the ground, 147 feet in spread, and 160 feet in height. Does New York State have a larger specimen?

Famous American Elms of New York reported in past surveys include the following:

Council Elm, Johnstown

Fort Stanwix, Sapling Elm, Rome

Caledonia Council Elm, Caledonia High School

Monument Tree of Cobleskill

Pioneer Elm, Ballston Lake

Republican Elm, Syracuse

Seneca Council Elm, Geneva

Lafayette Elm, Geneva

Torture Tree, Cuylerville

Friendship Elm, New York City

Elm of Italy Hollow, Potter-Middlesex

Markham Elm, Avon

The Gowanda Elm, Gowanda

Nott Elm, Union College, Schenectady

Council Elm, Oneida

Some of these trees are known to be gone—the Gowanda Elm, The Council Elm, Oneida, and the Seneca Council Elm, Geneva. The Lafayette Elm turned out to be a poplar. What is needed is to recheck the trees listed and to find others.

Anyone can help, especially hunters and other outdoorsmen likely to get into out-of-the-way places. To report the largest American Elm you know, send in a twig and foliage specimen (a branchlet without leaves will do) and your measurement of the circumference of the tree at 4½ feet above the ground, or at the narrowest diameter between the ground and the first limb. Also desired are: a clear photograph of the tree; a measurement of the spread of its branches in two directions, north to south, and east to west; measurement of its height, based on the

comparative shadow length of the tree and a man; also such information as a local name and any related historical data.

Location of the tree should be given, by county, township, or in some similar way, together with the name of someone who can give directions or accompany visitors to the tree.

Entry blanks that provide space for all needed information may be obtained from the Department of Floriculture, Cornell University, Ithaca, New York. Entries should be sent to the same address by December 1, 1954. Awards will be made on a county basis, and a State winner will be selected from among county winners.

## The 1954 Arnot Forest Workshop in Conservation Education

*By* Richard B. Fischer

The Sixth Teachers Conservation Workshop was held at the Arnot Forest near Van Etten on August 16 to 20, 1954. The New York State Conservation Council again provided money for scholarships, while facilities and instructional staff were supplied by the College of Agriculture at Cornell University.

This year's group came from 24 counties and included 20 elementary school teachers, 22 teachers of junior high and high school subjects, a grade supervisor, and a naturalist doing volunteer work with physically handicapped children. Encouraging was the number of teachers who came from urban schools, where conservation concepts are urgently needed in the students' experiences but are difficult to make meaningful.

Harry Kerr and Fred Winch did their customary excellent work in the areas of soil-water relationships and forest management, while Harlan Brumsted brought equal inspiration to his teaching of wildlife conservation and management. In assuming responsibility for organizing and participating in the Workshop, I hope I have carried forward the fine traditions of these unique experiences.

We were particularly fortunate in having the assistance of Cornell graduate students in the Division of Nature, Science, and Conservation Education. They were Herbert Frost, John Green, Ruth Josephson, Ethel Osborne, and Dora Worbs. All are experienced teachers.

A new physical feature at the Arnot this year was the cabin paid for and erected for us by the Niagara County Federation of Sportsmen. Nine teachers were the fortunate occupants of the building.

The sessions were similar to those of 1953. Although there were more optional activities than formerly, some workshoppers felt there should be *still* more. From their comments we are led to believe

*Our New Laboratory*
*The Division of Nature, Science, and Conservation Education, which prepares the Cornell Rural School Leaflet, invites readers to visit our new quarters, Rooms 3 to 10, Stone Hall*

the week was profitable for all.

Like others, this workshop is already beginning to bear fruit, for Mrs. Georgia Tuttle of the Van Etten Central School and Mr. L. Carleton Thayer of the John Marshall School in Rochester are organizing conservation workshops.

A prospectus concerning the 1955 Workshop will reach your principal or superintendent in late February. Should you wish nomination for a scholarship, may we suggest that you indicate your interest to the proper official? No teachers from the counties of Genesee, Seneca, Greene, Montgomery, and Warren have attended an Arnot Forest Workshop. Let's have these counties represented in 1955.

## The Radio Program, This Week in Nature

This weekly radio program continues under the direction of Professor Richard B. Fischer. He and his visitors discuss timely nature study topics, thereby supplementing the service of the Rural School Leaflet. The program is heard on Fridays at 2:15 p.m. on Station WHCU-AM and FM, and on stations of the Rural Radio Network on Saturday at 9 a.m.

## Some Useful References

### General Helps

Past issues of the *Cornell Rural School Leaflet* contain many suggestions and much useful information for children's and teacher's use. A list of those still available may be had from the Cornell Rural School Leaflet, Cornell University, Ithaca, New York. Files are in many schools and libraries.

*Elementary Science Textbooks.* For children, these are sources of information and further activities. For teachers they serve as a framework into which to integrate the various indoor nature studies.

*Audubon Nature Bulletins: The Fresh Water Aquarium, The Terrarium, Common Caterpillars, Adventures with Plants, How to Grow Plants in the Classroom, Selection of Plants for the Classroom.* National Audubon Society, 1130 Fifth Avenue, New York 28, New York. Clear, illustrated, inexpensive; part of a series of sixty helpful bulletins. Write for list.

*Elementary School Science Bulletins.* Issues 1-12, May 1952 to May 1954. Published by the National Science Teachers Association, 1201 Sixteenth St., N.W., Washington 6, D. C. Many appropriate suggestions.

*Field Book of Nature Activities.* By William Hillcourt. G. P. Putnam's Sons, New York City. 1950. 320 pages. Excellent material on most subjects considered in this Leaflet.

*Fieldbook of Natural History.* By E. Laurence Palmer. McGraw-Hill Book Company, New York City. 1949. 664 pages. Background information for teachers and older pupils.

*Handbook of Nature Study.* By Anna B. Comstock. Comstock Publishing Company, Ithaca, New York. 1939. 937 pages. Suggestions and information for teachers and older readers.

*Making and Using Classroom Science Materials in the Elementary School.* By Glenn O. Blough and Marjorie H. Campbell. Dryden Press, New York City. 1954. 229 pages. New, and helpful in many studies.

*Methods and Materials for Teaching Biological Sciences.* By David F. Miller and Glenn W. Blaydes. McGraw-Hill Book Company, New York City. 1938. 435 pages. Helpful for teachers and high school students.

*Natural Science Through the Seasons.* By J. A. Partridge. The Macmillan Company of Canada, Toronto, Canada. 1944. 520 pages. Many appropriate, graded suggestions.

*School Facilities for Science Instruction.* Edited by John S. Richardson, National Science Teachers Association, 1201 Sixteenth St., Northwest, Washington 6, D.C. 1954. 226 pages. Considers teach-

ing facilities at elementary, secondary, and college levels.

Books for teachers of elementary-school science (reviewed in previous Rural School Leaflets): *Elementary-school Science and How to Teach It,* Glenn O. Blough and A. J. Huggett, Dryden Press, New York City, 1951, 532 pages; *Science for the Elementary-School Teacher,* Gerald S. Craig, Ginn and Company, New York City, 1947, 561 pages; *Science in the Elementary School,* W. C. Croxton, McGraw-Hill Book Company, New York City, 1937, 454 pages; *Teaching Science in the Elementary School,* R. Will Burnett, Rinehart and Company, New York City, 1953, 541 pages; *Exploring Nature with Your Child,* Dorothy E. Shuttlesworth, Greystone Press, New York City, 1952, 448 pages.

**Aquariums and Terrariums**

*An Aquarium.* By Glenn O. Blough. Basic Science Education Series. Row, Peterson and Company, Evanston, Illinois. 1943. 36 pages. Good information on primary level.

*An Aquarium Book for Boys and Girls.* By Alfred P. Morgan. Charles Scribner's Sons, New York City. 1936. 180 pages. Excellent for teachers and upper grade pupils.

*Aquariums and Terrariums in Your Classroom.* Denoyer-Geppert Company, 5235 Ravenswood Avenue, Chicago, Illinois. Single copies free to teachers.

*Field Book of Ponds and Streams.* By Ann H. Morgan. G. P. Putnam's Sons, New York City. 1930. 448 pages. Excellent reference, including suggestions for aquarium studies. Older readers.

*Goldfish.* By Herbert S. Zim. William Morrow and Company, New York City. 1947. 64 pages. Much about aquariums. For grades 4 to 7.

*How to Establish and Maintain a Balanced Aquarium,* Service Bulletin No. 7. Ward's Natural Science Establishment, Inc., 3000 Ridge Road East, Rochester 9, New York. Single copies free to teachers; bulletins on other subjects also available.

*Life in an Aquarium.* By Mary Rogers Miller. Cornell Rural School Leaflet, Volume 46, Number 1, Fall 1952. Single copies free to teachers.

*Terraria and Aquaria.* Chicago Apparatus Company, 1735-43 N. Ashland Ave., Chicago, Illinois.

*Turtox Service Leaflets: Starting and Maintaining a Balanced Fresh-Water Aquarium,* No. 5; *The School Terrarium,* No. 10; *Plants for the Balanced Aquarium,* No. 11; *Notes on Marine Aquaria,* No. 20; *Feeding Aquarium and Terrarium Animals,* No. 23; *Aquatic Insects,* No. 33; *Aquarium Troubles : Their Prevention and Remedies,* No. 48, General Biological Supply House, 761-763 East 69th Place, Chicago 37, Illinois. Other leaflets are available. Low cost. Write for list.

*Your Aquarium: A Primer for Beginners.* By William T. Innes. Innes Publishing Company, Philadelphia 7, Pennsylvania. 1950. 33 pages. Helpful. Inexpensive.

**Pets and Their Care**

*The Book of Wild Pets.* By Clifford B. Moore. Charles T. Branford Company, Boston, Massachusetts. 1954. 553 pages. Helpful information about aquariums, and about wild pets of many kinds.

*A Pet Book for Boys and Girls.* By Alfred P. Morgan. Charles Scribner's Sons. 1949. 246 pages. Clear, detailed, well illustrated. For young readers.

*Pets.* By Frances N. Chrystie. Little, Brown and Company, Boston, Massachusetts. 1953. 272 pages. Care, understanding, and appreciation of many kinds of pets.

**Plants and Plant Studies**

*The Care of Plants in the Home,* by Kenneth Post, Cornell Extension Bulletin 623; *Growing Garden Flowers from Seed,* by R. C. Allen, Cornell Extension Bulletin 579; *Plants and Flowers Indoors,* by Ernest Schaufler, 4-H Home Grounds Improvement Leaflet 1, May 1954. Mailing Room, Stone Hall, Cornell University, Ithaca, New York. Single copies free to residents of New York State.

*African Violets; Forcing Bulbs for Indoor Bloom; Forcing Spring Flowers; Grow Plants from Cuttings in the Home; Making of Dish Gardens; Tender Narcissus for Winter Bloom; Terrariums.* Leaflets available free on request from the Department of Floriculture, Cornell University, Ithaca, New York. Many more leaflets of interest to gardeners are included in this series. Ask for a list.

*Garden Indoors.* By Bertha M. Parker. Basic Science Education Series. Row, Peterson and Company, Evanston, Illinois. 1944. 36 pages. Useful information on growing plants, and on terrariums. Grades 5 to 7.

*Bits That Grow Big: The Story of Plant Reproduction.* By Irma E. Webber. William R. Scott, Inc., New York City. 1949. 64 pages. Many easy-to-do experiments. Grades 3 and 4.

*Plants in the City.* By Herman and Nina Schneider. The John Day Company, New York City. 1951. 96 pages. Many activities and clear helpful drawings. For grade 4 and up.

*Play with Plants* (1949, 63 pages); *Play with Trees* (1950, 64 pages); *Play with Vines* (1951, 63 pages); *Play with Leaves and Flowers* (1952, 64 pages). All by Millicent Selsam. William Morrow and Company, Inc., New York City. Attractive, and full of useful information and suggestions for activities. Grade 3 and up.

*All About House Plants.* By Montague Free. Doubleday and Company, Inc. Garden City, New York. 1946. 329 pages.

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